AN INFORMETRIC ANALYSIS OF HIV/AIDS RESEARCH IN EASTERN AND SOUTHERN AFRICA, 1980-2005

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DECLARATION

I wish to declare that this thesis, "An Informetric Analysis of HIV/AIDS Research in Eastern and Southern Africa, 1980-2005", except where specifically indicated to the contrary within the text, is my original work, and has not been presented for a degree in any other university. All the sources used in this work have been acknowledged by means of references

....	29th March 2007
Onyancha, O. Bosire	Date

....	29/03/07
Promoter (Prof. Dennis N. Ocholla)	Date

DEDICATION

To my loving wife Margaret and children, Kevin Gichana, Faith Moraa, and Emmanuel Mogusu, for their warm love, support and understanding

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LIST OF ACRONYMS AND ABBREVIATIONS

AfHRF	African Health Research Forum
AIDS	Acquired Immunodeficiency Syndrome
ANG	Angola
ARVs	Anti-Retrovirals
BW	Botswana
DJ	Djibouti
E&S Africa	Eastern and Southern Africa
EAC	East African Community
ER	Eritrea
ETH	Ethiopia
HIV	Human Immunodeficiency Virus
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
HIVNET	NIH's HIV Network for Prevention Trials
IF	Impact Factor
ISI	Institute for Scientific Information
ITM	Institute of Tropical Medicine
JCR	Journal Citation Reports
KE	Kenya
KEMRI	Kenya Medical Research Institute
KS	Kaposi's Sarcoma
LDCs	Less Developed Countries
LE	Lesotho
LIS	Library and Information Science
MAL	Malawi
MOH	Ministry of Health
MOZ	Mozambique
MTCT	Mother-to-Child Transmission
NAM	Namibia

NGO	Non-Governmental Organization
NIAID	National Institute of Allergy and Infectious Diseases
NIH	National Institutes of Health
NLM	National Library of Medicine
OA	Open Access
OIs	Opportunistic Infections
OTA	U.S Office of Technology Assessment
PC	Personal Computer
PRB	Population Reference Bureau
S. AFR	South Africa
SADC	Southern African Development Community
SCI	Science Citation Index
SOM	Somalia
SSCI	Social Sciences Citation Index
STDs	Sexually Transmitted Diseases
SUD	Sudan
SW	Swaziland
TZ	Tanzania
UG	Uganda
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNDP	United Nations Development Programme
UNICEF	United Nations International Childrens Fund
VTN	NIH's Vaccine Trials Network
WHO	World Health Organization
WWW	World Wide Web
ZAM	Zambia
ZIM	Zimbabwe

GLOSSARY

This study accepts and adopts the standard definitions of terms as they are presented in key medical and other authority sources (e.g. dictionaries).

Collaboration: A process where two or more individuals or organizations deal collectively with issues of common interest

Database: A collection of information and data stored in a computer (i.e. computer file or CD-ROM) in a systematic way

Disease: Any abnormal condition of the body or mind that causes discomfort or distress to the person affected or those in contact with the person.

Epidemic: A sudden unusual increase in cases that exceeds the number expected on the basis of experience

Epidemiology: The study of the distribution and determinants of disease and injury in human populations

Grey literature: Information sources which are not available through normal book-selling channels (e.g. theses, reports, conference records, patents, standards, etc).

Impact: Ratio of the total number of citations received by documents to the total number of documents in the group

Influence: The tendency of an author, document, or journal to be cited by another author, document, or journal.

Opportunistic Infections: Infections that usually don't cause disease in a person with a healthy immune system but can affect people with poorly functioning or suppressed immune systems because of immunodeficiency or immunosuppression.

Pandemic: An epidemic occurring simultaneously in many countries

Prevalence: The number of people with a disease at a point in time often expressed as a percentage of the total population

Research: An active, diligent and systematic process of inquiry in order to discover, interpret or revise facts, events, behaviors, or theories, to make practical applications with the help of such facts, laws or theories

Research collaboration: A concept of two or more researchers (or researchers from two or more organizations or countries) working together

Risk factors: Habits, characteristics or factors which can increase one's likelihood or odds of developing HIV/AIDS

ABSTRACT

HIV/AIDS is said to be a new type of global emergency – an unprecedented threat to human development requiring sustained action and commitment over a long term. Nowhere is its impact felt more than in Sub-Saharan Africa, even more so in Eastern and Southern Africa. HIV/AIDS, in all its dimensions, demands novel alliances between the social and biological sciences, particularly when it comes to designing effective interventions to prevent or treat the complications of HIV transmission. This study therefore sought to provide decision makers and other stakeholders with a tool to use when formulating policies on HIV/AIDS intervention programs. To that end, the study set out to examine the research output and impact of HIV/AIDS by identifying and determining its nature, types, and trends in Eastern and Southern Africa as indexed and reflected in the MEDLINE, Science Citation Index (SCI) and the Social Sciences Citation Index (SSCI) databases.

Specifically, the study's focus was:

- To examine the nature, trend and type of HIV/AIDS research collaboration in E&S Africa between 1980 and 2005 with a view to recommend ways of improving or strengthening such collaborative activities.
- To examine the growth, productivity and scientific impact of HIV/AIDS sources of information [source publications] as they relate to E&S Africa between 1980 and 2005 in order to assess the visibility and coverage of HIV/AIDS sources and to provide relevant information so as to assist information providers, users in general, and more specifically, collection development librarians, particularly in the two regions, in their decision making processes regarding the identification, selection and development of relevant HIV/AIDS resources
- To evaluate the performance of individual authors, institutions and countries in terms of their productivity and scientific impact with a view to: (a) identify the most prolific and influential researchers, countries and institutions that conduct HIV/AIDS research in and about E&S Africa and (b) to compare the productivity and scientific impact of domestic/regional authors, institutions, and countries with their foreign counterparts.

- ❖ To assess the publishing activity in the fields/topics of HIV/AIDS research in order to: (a) distinctly bring out a clear picture on the efforts made in the various sub-fields of HIV/AIDS research and (b) to find out the relatedness of the risk factors, opportunistic infections, pre-disposing factors, sexually transmitted diseases and other tropical diseases that are common in Africa to HIV/AIDS.

Using informetrics (as a research method) and more specifically publications count and citations count and analyses, relevant data was extracted from three key bibliographic databases (i.e. MEDLINE, SCI and SSCI) through an advanced search strategy which was employed to search and download HIV/AIDS documents specific to Eastern and Southern Africa using the Title, Abstract, Authors address and Subject Fields. This was accomplished by combining the names of the countries and 26 HIV/AIDS-specific terms which included the terms by which HIV/AIDS was known at the beginning of the epidemic. The downloaded data was analyzed using various computer-aided bibliographic software that included Sitkis version 1.5 ©2005, Microsoft Office Access ©2003, Microsoft Office Excel ©2003, Bibexcel ©2005, Citespace version 2.0.1 ©2005, TI, UCINET for Windows ©2002, and Pajek version 1.08 ©1996.

The findings show that HIV/AIDS research in E&S Africa is largely conducted through collaboration, as illustrated by the number of co-authored papers, which accounted for over 70% of the total number of papers in each country. Research collaboration between E&S African countries is minimal when compared to the collaborative activities between these and foreign countries (i.e. countries outside Africa). This type of collaboration was predominant, and collaboration between E&S African countries and the rest of Africa was found to be almost non-existent, with the countries in West Africa recording a comparatively higher pattern than North African countries. Institutional collaboration is mainly between universities. Nevertheless, industry-university collaboration was visible, especially between government laboratories, ministries or teaching hospitals and the university, which to a large extent was responsible in the day-to-day running of the hospital teaching facilities/programs. It was also observed that there has been a remarkable growth in the number of HIV/AIDS researchers' networks between 1980 and

2005. The composition of these networks shows a high pattern of collaboration between local and foreign researchers. Finally, it was noted that research collaboration increases the average impact by 12.75 citations, while research conducted by individual researchers increases the average impact by only 3.48 citations.

Concerning the sources of HIV/AIDS research, it was noted that the coverage of sources published in E&S African countries in key bibliographic databases is minimal, with the MEDLINE database indexing only 14 (1.01%) serials, while SCI and SSCI respectively covered 23 (1.65%) and 4 (0.29%) of the total 1393 serials published in the regions. Furthermore, sources that publish HIV/AIDS research on E&S Africa are evenly distributed in the MEDLINE and ISI databases, although about 50% of the total research output is unique in each database. Other observations were as follows: (a) journals are the most commonly used sources and channels in publishing and disseminating HIV/AIDS research on E&S Africa. The second most preferred source and channel was that of newspapers; (b) the number of sources publishing HIV/AIDS research on E&S Africa has exponentially increased over the period under study, i.e. 1980-2005, thereby posing serious challenges to collection development librarians and researchers/authors; (c) sources that publish HIV/AIDS research on E&S Africa are largely published in foreign countries. Out of the total 804 and 823 HIV/AIDS sources in MEDLINE and ISI, respectively, 92.54% and 97.57% were published in foreign countries, while locally published sources accounted for 3.73% and 2.19% of the total source publications in MEDLINE and ISI, respectively; (d) most HIV/AIDS research on E&S Africa is published in relatively low impact factor journals. Out of the total 823 sources in ISI, only 11 sources had an impact factor of more than 10.0; (e) HIV/AIDS research on E&S Africa is largely published in medical science-specific source publications, and more particularly, in general medical sources; and (f) there are about 13 core sources of HIV/AIDS research, namely, AIDS, LANCET, J INFECT DIS, NEW ENGL J MED, J VIROL, J ACQ IMMUN DEF SYND, JAMA, AIDS RES HUM RETROV, SCIENCE, BRIT MED J, S AFR MED J, SOC SCI MED, and J CLIN MICROBIOL.

An analysis of the data according to the producers of HIV/AIDS research yielded the following findings: (a) a relatively high number of countries (i.e. 120) have been or are engaged in conducting HIV/AIDS research about E&S Africa; (b) HIV/AIDS research is evenly conducted in and/or by regional and foreign countries. Counting the frequencies of occurrence of each country in the address field yielded a total sum of 7041 occurrences for foreign countries and 6161 for African countries; (c) most HIV/AIDS research about E&S Africa is published in foreign countries, which accounted for approximately 83% and 88% of the total research papers in MEDLINE and ISI, respectively; (d) HIV/AIDS research is largely conducted by or at universities; and (e) the impact of HIV/AIDS research in and about E&S Africa has continued to increase as illustrated by the continued growth of the number of citations between 1980 and 2005. Nevertheless, a relatively huge amount of HIV/AIDS research (26.2%) remains uncited.

Concerning the subject content of HIV/AIDS research, the following were the main observations: (a) the number of keywords/terms that are used to index HIV/AIDS research outputs has exponentially grown, thus providing a number of options for accessing HIV/AIDS research findings; (b) HIV/AIDS-specific terms (i.e. HIV infections and Acquired Immunodeficiency Syndrome) are the major keywords by which HIV/AIDS research findings can be accessed in the indexing services/databases; (c) HIV/AIDS research in E&S Africa is mostly on the sub-fields of epidemiology, prevention & control, transmission, complications, and Drug therapy; (d) drug therapy and Anti-Retrovirals (ARVs) are quickly emerging as the main areas of HIV/AIDS research in E&S Africa; and (e) HIV/AIDS is strongly associated with opportunistic infections, pre-disposing factors, risk factors, sexually transmitted diseases and other tropical diseases that are common in Sub-Saharan African countries.

Finally, the study, while commending researchers in the region for their collaborative efforts, recommends that research collaboration, both at the national and international level, should be encouraged through such means as organizing international conferences within E&S Africa where researchers can exchange ideas and in so doing they can identify researchers from other countries with whom they can collaborate. Regarding the dissemination of HIV/AIDS research through publications, it was recommended that researchers be encouraged by way of incentives to present the findings in regionalized conferences as well as publish them in both print and electronic conference proceedings while publishing the papers in foreign sources. For purposes of visibility and impact, local journal publishers should endeavor to publish their journals both electronically and in print. In this way, both researchers and sources that publish HIV/AIDS research would receive a wider visibility and produce higher impact.

In conclusion, it is hoped that the findings of this study will support HIV/AIDS researchers, funding organizations, AIDS prevention and control institutions, public health professionals, information service professionals, and government health ministries, among others, looking for information which can improve the quality of their decision making and/or increase their competitive intelligence.

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CHAPTER ONE

INTRODUCTION AND BACKGROUND TO THE STUDY

1.1 Background to the study

The Eastern and Southern spheres of Africa (henceforth abbreviated as E&S Africa) are among many regions of the developing world that have suffered from war, crime, poverty, corruption, and diseases. Killer diseases such as malaria, meningitis, cholera, typhoid fever, Ebola and measles have exerted both social and economic pressure on the peoples of Sub-Saharan Africa. The subject of this study, a disease that has drawn significant attention owing to its pandemic nature, is the Acquired Immunodeficiency Syndrome (AIDS). The disease is a clinical syndrome that results from the Human Immunodeficiency Virus (HIV). Henceforth referred to as HIV/AIDS, the disease causes severe suppression in the body's immune system and is believed to be the final stage of HIV infection. Brookmeyer & Gail (as cited in Onyancha & Ocholla, 2005:1574) state that when the CD4 + T-cells, defined as "*central elements in the control of both humoral and cell mediated immune defenses*", fall below 200, HIV infected persons become highly susceptible to opportunistic infections such as *Pneumocystis Carinii Pneumonia* (PCP), malignancies, and other death inducing illnesses. According to the United Nations Secretary General, Koffi Annan, "*AIDS is a new type of global emergency – an unprecedented threat to human development requiring sustained action and commitment over a long term*" (UNAIDS, 2004:7).

Following its first clinical diagnosis in 1981 in Los Angeles, USA, when five young homosexual men were treated for biopsy-confirmed *Pneumocystis Carinii Pneumonia* Begley, Check, Wingert & Conway, 2001; Konforti, 2001; National Institute of Allergy and Infectious Diseases [NIAID], 2003), the pandemic has spread and continued to ravage families, communities, and countries throughout the world. Globally, an estimated 35 million people were infected with HIV/AIDS by 2000, and nearly 70% of all HIV transmissions and people living with HIV infections then resided in Sub-Saharan Africa. Although the disease's prevalence appears to be declining in some parts of the world, the situation in Africa remains dire. According to UNAIDS (2006:8), "*an estimated 38.6 million [33.4 million–46.0 million] people* *worldwide were living with HIV in 2005... An estimated 4.1 million [3.4 million–6.2 million] became newly infected with HIV and an estimated 2.8 million [2.4 million–3.3 million] lost their lives to AIDS*".

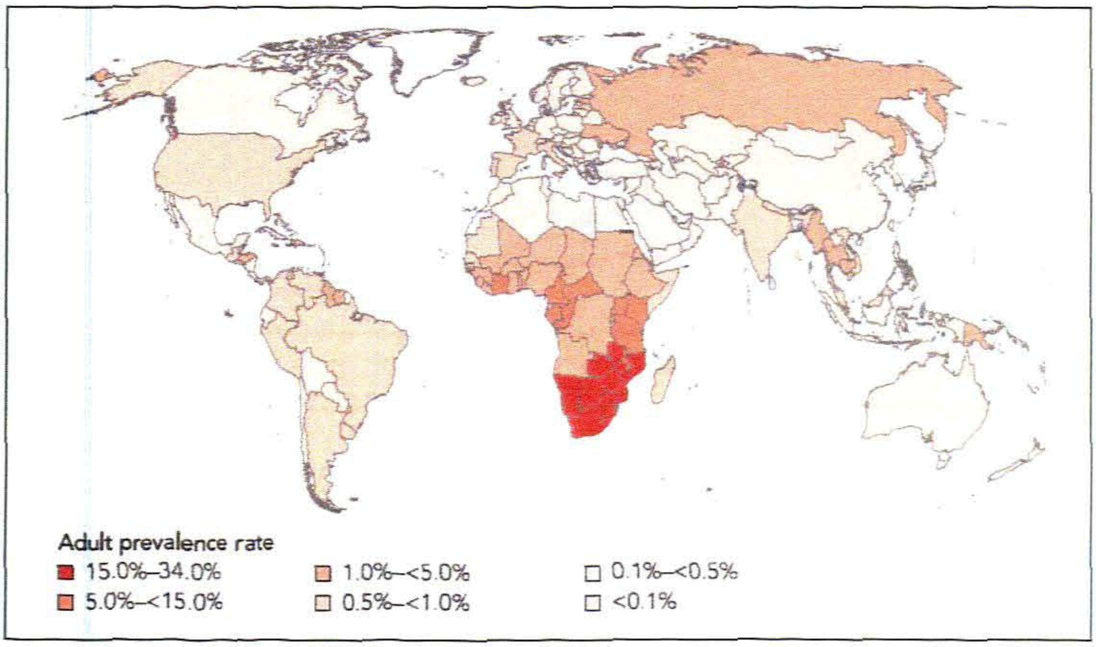

Fig. 1.1: A global view of HIV Infection (Source: UNAIDS, 2006: http://www.unaids.org)

The global HIV/AIDS trend, as shown in Fig. 1.2, indicates that the epidemic's prevalence rate is on the increase. The number of people living with HIV continues to rise as the prevalence rates among adults exhibit the same trend for the last decade. From a mere approximate of 9 million people infected with HIV in 1990, the number of adults and children living with HIV/AIDS has grown to the unprecedented figure of 38.7 million, a percentage increase of 330%.

Lamptey, Wigley, Carr & Collymore (2002) note that 14000 people – 12000 adults and 2000 children – become infected daily and at least 95 percent of these new infections occur in developing countries. If this is to remain the status quo, it is estimated that there will be 45 million new HIV infections by 2010. Summarily, the nature of the epidemic "*remains extremely dynamic, growing and changing character as the virus exploits new opportunities for transmission*" UNAIDS, 2004:23).

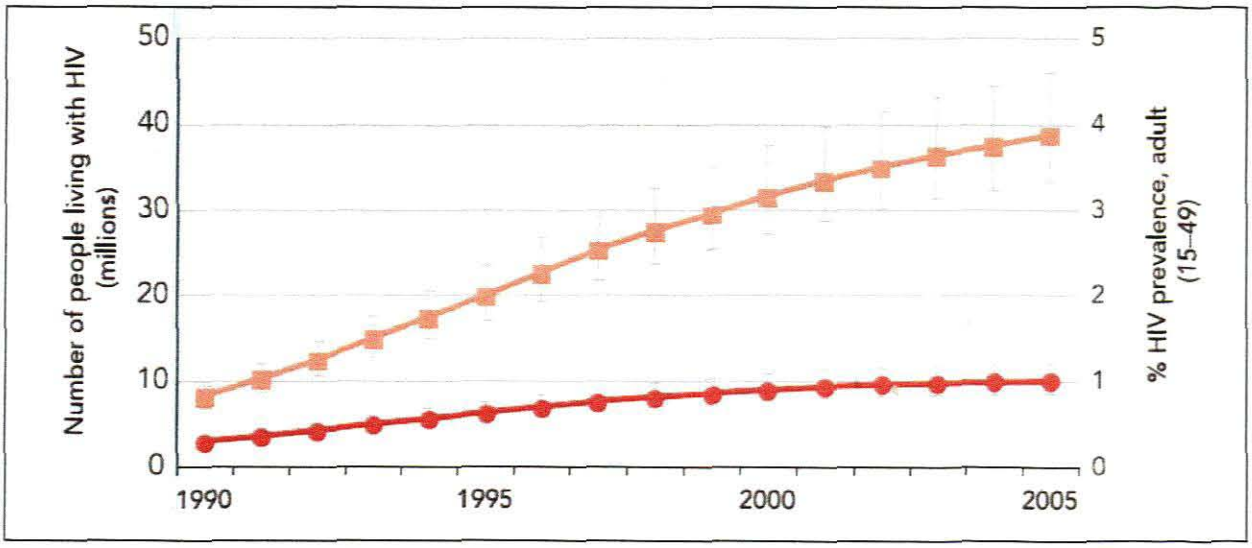

Fig 1.2: Global AIDS epidemic 1990-2005 (Source: UNAIDS, 2006)

Sub-Saharan Africa is said to be the hardest hit. With a total population of 733 million, the region is currently home to 24.5 million people living with HIV/AIDS. In 2003 alone, the disease claimed 2.2 million lives, and left 12.1 million children destitute. There are more AIDS-related deaths than any caused by other factors in the region. South Africa's former president, Nelson Mandela, observed that AIDS in Africa is claiming more lives than the sum total of all wars, famines, floods, and the ravages of deadly diseases such as malaria (Moeller, 2000:para 5). Similarily, Moeller observes that:

> *"In 1998, death from all wars in Africa killed 200,000 people. AIDS killed 10 times that number. The statistics are numbing: six Africans each minute are stricken with the HIV virus; in 10 years the number of AIDS orphans in Africa will reach 29 million, and AIDS is expected to kill between one-third and one-half of today's 15-year-olds"* (Moeller, 2000:para 5).

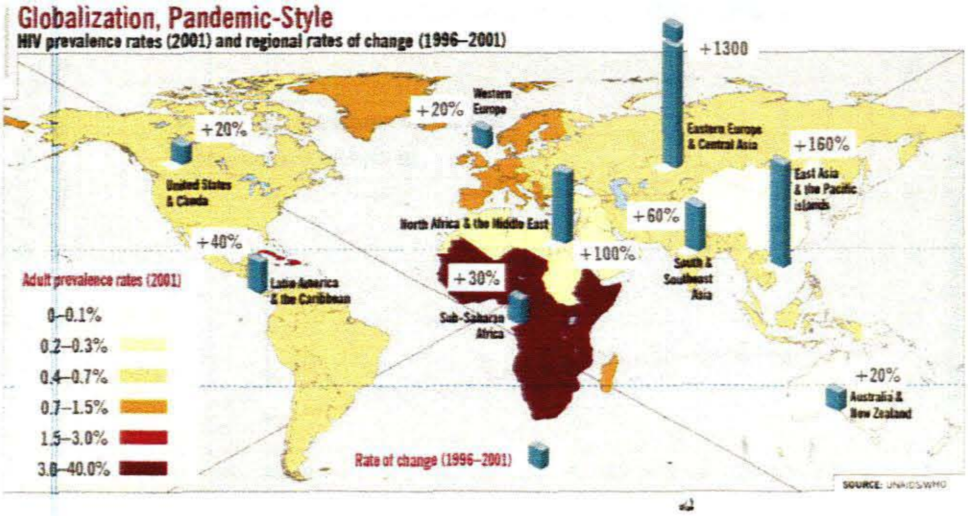

Fig. 1.3: Source: Carnegie Endowment for International Peace (2004)

When compared to the rest of the world, sub-Saharan Africa's adult HIV prevalence rates were as high as 30% in 2001, the highest in the world, as shown in Fig. 1.3. Fig 1.4 illustrates that for more than two decades, HIV prevalence has continued to increase at an alarming rate in the region. However, as the Population Reference Bureau (PRB) reports, the recently released global estimates of the United Nations Joint Programme on HIV/AIDS (UNAIDS) provide hope for the region (PRB, 2004). The region witnessed a decline in the prevalence rate of 0.1% - from 7.6% to 7.5% between 2001 and 2003. Within this period, fourteen countries in sub-Saharan Africa recorded a decline in HIV/AIDS prevalence. Leading these countries were Kenya and Uganda.

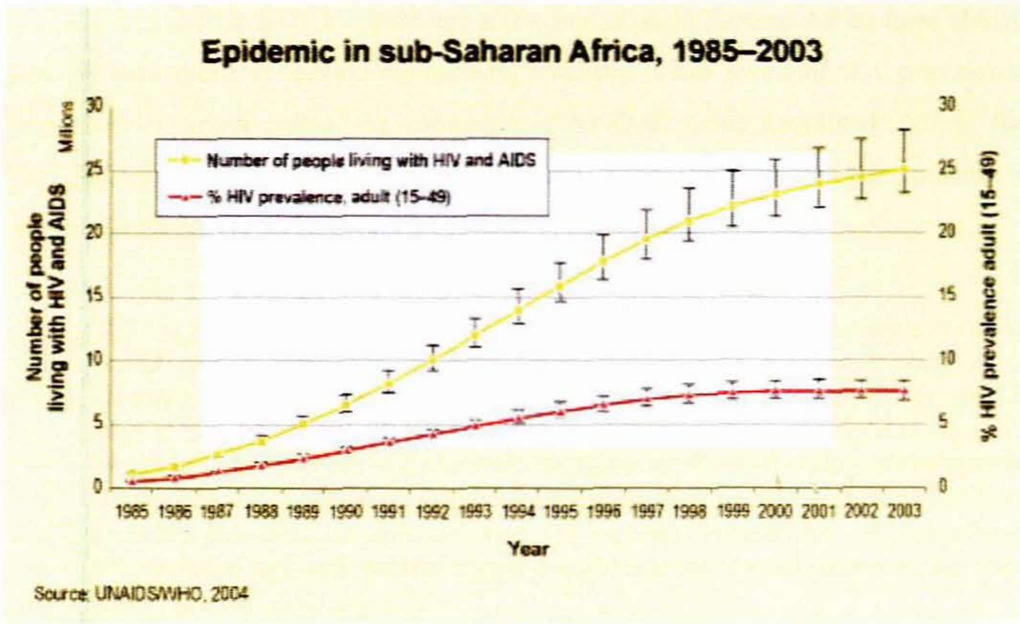

Fig. 1.4: AIDS Epidemic in sub-Saharan Africa, 1985-2003 (Source: UNAIDS, 2004)

Despite the cited reduction of prevalence rates in some countries, an analysis of the HIV/AIDS situation in E&S Africa reveals a grave scenario. The two regions are home to approximately 17.4 million people living with HIV/AIDS, or 69.4% of the total number of people infected with HIV in sub-Saharan Africa. Eastern Africa houses 5.8 million (23.2% of sub-Saharan cases) individuals, while Southern Africa is home to 11.6 million people (46.2% of sub-Saharan cases). UNAIDS reports that HIV prevalence has persisted at alarmingly high levels in the general population across the region (UNAIDS, 2003a). The report estimates that about 30% of people living with HIV/AIDS worldwide live in Southern Africa, yet this region has less than 2% of the world's population. Despite concerted efforts to control the AIDS epidemic in Africa, particularly in E&S Africa, the disease shows no signs of slowing down.

Even more startling is the revelation that whereas people in other developing countries/regions such as South Asia expect to live longer now, HIV/AIDS is reversing life expectancy in Africa. UNAIDS puts it thus "*people living in South Asia, who could barely expect to reach their 40th birthday in 1950, can expect by 2005 to be living 22 years longer than their counterparts in AIDS-ravaged Southern Africa*"

(UNAIDS in WHO, 2001:4). Although a few countries in Eastern Africa have shown positive indications in curbing the malady, resulting in low levels of HIV prevalence (especially in urban areas), the pandemic is far from being contained. Aznar, the UNESCO Communication Adviser for Eastern Africa, summarizes the epidemic's status in E&S Africa as follows:

> *"The spread and prevalence of HIV/AIDS in E&S Africa is the highest in the world and it continues to grow exponentially and we are looking at a catastrophe of unimaginable proportions especially in this part of the world. And if we agree that for as much as statistics show we have a massive problem, what they do not show is the agony of the day to day life of people living with AIDS. The time bomb keeps ticking and we all know that unless we individually – and as representatives of concerned institutions – do something, the situation will only get worse and possibly out of control sooner rather than later" (Aznar, 2002:para 3).*

Because of factors such as those outlined above, internationally recognized organizations such as the World Health Organization, United Nations Development Programme (UNDP), World Bank, UNAIDS, and various governmental and non-governmental agencies have committed large amounts of financial resources to fighting the disease, not only in Africa but also the rest of the world. Much of this money has been directed towards research activities. Although the estimated global expenditure on AIDS research is not known, some have observed that the "*World Bank committed over US $ 550 million to HIV/AIDS prevention and mitigation efforts*" between 1986 and 1996 (Dayton, 1998:1). The projected international expenditure on AIDS programs by donor nations, international lending institutions and other private organizations for the year 2003 was US$ 2.6 billion (UNAIDS, 2003b).

In addition to epidemiologists, physicians, scientists, and policy makers, other professionals are increasingly getting involved in solving problems associated with the disease. For instance, social scientists have been called upon to render biosocial approaches in comprehensively understanding the epidemic. As Farmer (1999) argues, AIDS in all its dimensions demands novel alliances between the social and biological sciences, particularly when it comes to the design of effective interventions that prevent or treat the complications of HIV transmission. This approach appears to have gained prominence among key players. Lately major projects, conferences, seminars and workshops on HIV/AIDS have incorporated professionals from different disciplines (Onyancha, 2006).

1.2 Problem Statement

These cited factors and efforts have resulted in a proliferation of publications, not only in the global arena, but also in and about E&S Africa. Although there have been informetric studies on HIV/AIDS in other parts of the world, very little has been achieved in this field in Africa, particularly in E&S Africa. As Narvaez-Berthelemont, Russell, Arvanitis, Waast & Gaillard (2001:469) observed in their study on *Science in Africa*, "*the African region has received little attention from the scientometric perspective*". Consequently, the characteristics of this literature (or research) as published by and about E&S Africa, in addition to their citations count and scientific impact are unknown.

It has also been observed that African countries enjoy strong collaborative links with the rest of the world in malaria research (Beattie, Renshaw, & Davis, 1999). With regard to HIV/AIDS, Macias-Chapula & Mijangos-Nolasco (2002) noted a high pattern of collaboration amongst two or more authors (i.e. 91.54%) in a *Bibliometric analysis of AIDS literature in Central Africa*. The types and trends of this collaboration, i.e. inter-institutional, inter-national, etc., have, however, not been identified.

Serials in general, and journals in particular, are increasingly becoming major sources of HIV/AIDS information, hence assuming the role of effective and reliable tools that can be employed in combating the disease. These and other sources have tremendous reach and influence, and provide the means to, as well as play a significant role towards, successfully leading a campaign against the pandemic. Scientific journals play a vital role in the dissemination of research results through publications, whose importance in advancing the careers of scientists increases the possibilities of these journals influencing research priorities (Momen, 2004). The visibility and impact of HIV/AIDS journals as well as the identification of core resources of HIV/AIDS research in the region are aspects that have not been adequately explored.

According to Brown (1993:12), "*AIDS researchers around the world are under greater pressure than ever before to justify their existence*". These researchers' continued funding is drawing a lot of interest from the public, who question the rationale for the extensive sums of money channeled towards AIDS research given that neither a vaccine nor cure has been discovered. Annually, considerable research funds are allocated to Sub-Saharan African countries, where the pandemic is more severe. An informetric investigation of AIDS literature on E&S Africa as indexed in key bibliographic databases may shade more light on the authors' productivity and individual and institutional scientific impact.

Cohen (2000b) opines that AIDS in Africa is a distinct disease. In a letter written by Thabo Mbeki in 2000 to world leaders, the South African president also observed that "*it is obvious that whatever lessons we have to and may draw from the West about the grave issue of HIV/AIDS, a simple superimposition of Western experience on African reality would be absurd and illogical*" (as cited in Cohen, 2000b: para 1). Not only do the manifestations of the AIDS disease in Africa differ from those in the West but, even within Africa, they differ from place to place. Cohen (2000b) observes that AIDS-related diseases, and possibly disease progression itself, differ on the continent that is home to about 71% people infected with HIV. An analysis of the relatedness of factors such as opportunistic infections, risk factors, pre-disposing factors, sexually transmitted diseases and other tropical diseases, to HIV/AIDS in Sub-Saharan Africa, as well as an examination of the terms most commonly used to index HIV/AIDS literature, may assist in determining the uniqueness of HIV/AIDS in Africa.

1.2.1 Research goals

The purpose of this study is to broadly examine the research output and research impact of HIV/AIDS by identifying and determining its nature, types, and trends in E&S Africa, as indexed and reflected in the MEDLINE, Science Citation Index (SCI) and the Social Sciences Citation Index (SSCI) databases. MEDLINE is produced by the National Institutes of Health (USA), while the SCI and SSCI are products of the Thomson Scientific (formerly and henceforth known as the Institute for Scientific Information, in short ISI).

In light of this, the study sought to fulfill four broad objectives/goals, summarized as follows:

1. To examine the trend and type of HIV/AIDS research collaboration in E&S Africa with a view to recommending ways of improving or strengthening such collaborative activities.
2. To examine the growth, productivity and scientific impact of HIV/AIDS sources of information [source publications] as they relate to E&S Africa between 1980 and 2005 in order (a) to assess the visibility and coverage of HIV/AIDS sources in three key bibliographic databases and (b) to provide relevant information that assists information providers, users and more specifically, collection development librarians, particularly in the two regions, in their decision making processes regarding the identification, selection and development of relevant HIV/AIDS resources.
3. To evaluate the performance of individual authors, institutions and countries in terms of their productivity and scientific impact in order to (a) identify the most prolific and influential researchers, countries and institutions that conduct HIV/AIDS research in and about E&S Africa and (b) compare the productivity and scientific impact of domestic/regional authors, institutions, and countries with those of their foreign counterparts.
4. To examine the subject content of HIV/AIDS research on E&S Africa so as to (a) distinctly bring out a clear picture on the efforts made in the various sub-fields of HIV/AIDS research and (b) to find out the influence of selected aspects that are related to HIV/AIDS in Africa on the disease. As a result it sought to fulfill the following specific objectives.

Each of these objectives articulated the main purpose of each chapter dealing with data presentation and interpretation. Specific focus areas with respect to the above broad objectives were formulated and formed the basis of Chapters four to seven.

1.2.2 Research questions

The following broad research questions defined the focus areas of this study. Each of these questions was decomposed into specific sub-questions as presented in Chapters four to seven.

1. What are the various natures, trends, and types of HIV/AIDS research collaboration in E&S Africa?
2. What is the growth rate, productivity and scientific impact of HIV/AIDS information sources [source publications] as they relate to E&S Africa?
3. What is the performance of individual authors, institutions and countries in terms of their HIV/AIDS research productivity and scientific impact?
4. Which sub-fields of HIV/AIDS research are the most commonly researched topics?
5. Is HIV/AIDS in Africa a distinct disease?

1.3 Motivation for the study

A number of factors aroused interest in conducting this study. Some of these motivational factors include the following:

- **The ever-increasing cases of AIDS in E&S Africa and the urge to contribute in the fight against it.** Apart from Uganda, whose success stories in the prevention and control of HIV/AIDS dominated media headlines in the 1990s, few countries in E&S Africa have shown positive indications in curbing the disease. UNAIDS (2003a) reports that in a belt of countries across Southern Africa, HIV prevalence remains alarmingly high in the general population. In other sub-Saharan African countries, the epidemic has gained a firm foothold and shows little sign of weakening. This calls for concerted efforts necessary to eradicate the epidemic. The situation demands collaborative efforts between researchers from various disciplines, an endeavor that may inject new approaches into the fight against the disease. It is this researcher's belief that an informetrics study on HIV/AIDS research could offer valuable assistance in combating HIV/AIDS, particularly with regard to policy formulation on intervention programs.

- **The researcher's successful completion of a Masters degree in Library and Information Science.** The researcher previously conducted a bibliometric study on corruption literature in Africa using four electronic databases: EBSCO's Master File Premier and Academic Search Premier and Institute for Scientific Information's (ISI's) Science Citation Index (SCI) and Social

Sciences Citation Index (SSCI). A more challenging endeavor was necessary in order to equip the researcher with more skills and techniques and prepare him to undertake future research evaluation tasks.

- ❖ **New technologies and tools that have made informetrics a more challenging subject area in library and information sciences**. As Wormell (2000132) rightly notes, "*advanced online search facilities and information retrieval techniques have considerably increased the potentialities of bibliometric research methodology and are opening new possibilities for tracking down analytical information from large collections of bibliographic data*". New technologies such as online databases, the World Wide Web, and the Internet, bring along with them varied and complex challenges, especially in knowledge management, information retrieval, and text mining, whose valuable solutions can be supplied by informetricians.

- ❖ **Scarcity of Informetricians in sub-Saharan Africa.** Informetric studies and informetricians are rare in sub-Saharan Africa, a situation that has led to Africa not enjoying its full potential particularly due to the lack of relevant information for appropriate decision-making processes.

- ❖ **Popularization of Informetrics in Africa as a whole and E&S Africa, in particular.** The benefits of informetrics (some of which are outlined under the heading 'Significance/value of the study') as a research method and the value of the results obtained from informetric studies are well known. We intend to disseminate the findings widely and in this way, it is expected that many will appreciate the use of informetrics. The lack of knowledge about the value of informetrics in conducting research evaluation is illustrated in the following observation that was made by the South African Universities Vice-Chancellors Association's Higher Education HIV/AIDS Programme (2004:xii): "*Overall, HEAIDS considers promotion of research on HIV and AIDS an important element of the institutional response. However, the audit was unable to obtain detailed, quantitative information because of time constraints and limited availability of information from the institutions' heads of research. Moreover, the audit demonstrates that research outputs are difficult to track because of* *large number of departments in each HEI*". In their recommendations, the Vice-Chancellors advised that "*HEIs [Higher Education Institutions] should encourage better tracking of research progress and output with regard to HIV and AIDS*" (South African Universities Vice-Chancellors Association's Higher Education HIV/AIDS Programme, 2004:xii) which in the researcher's opinion can be supplemented through informetric studies.

1.4 Scope and limitations of the study

This study covered:

- All HIV/AIDS documents published and indexed in the MEDLINE, Science Citation Index (SCI), and the Social Sciences Citation Index (SSCI), published in or about E&S Africa from 1980 to 2005
- Special references to the analysis of article citations published in and about E&S Africa
- Journal articles, book reviews, letters to the editors, editorials, theses, conference proceedings, meeting abstracts, and evaluation studies, as they relate to HIV/AIDS in E&S Africa, were some of the document types that fell within the scope of this study.
- Eighteen mainland countries within the region of E&S Africa, namely, Angola, Botswana, Djibouti, Eritrea, Ethiopia, Kenya, Lesotho, Malawi, Mozambique, Namibia, Somalia, South Africa, Sudan, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe.
- Informetric analytic approaches (i.e. publications count, co-word analysis and citation count and analysis) were used to analyze HIV/AIDS literature.

1.5 Delimitations of the Study

This study was intended to be as comprehensive as possible. Despite this, the study did not cover the following areas:

a. Since this study was limited to E&S Africa, the countries of Rwanda and Burundi were excluded because they are commonly considered to be part of Central Africa
b. The islands (island countries) of E&S Africa
c. HIV/AIDS published papers that were not covered by the three databases since the focus was only on publications covered in the databases.

d. Unpublished HIV/AIDS papers not covered in the databases, e.g. theses and dissertations, for the same reason as c above.

1.6 Significance/Value of the Study

Generally speaking, the benefits of research evaluative studies are said to be the "*increased efficiency of research investment, transparency in how and why investment decisions are made and accountability to stakeholders in terms of the impacts produced from the funds provided*" (Spilsbury, 2000). Therefore, this study's purpose was to provide relevant information that may be of use to other researchers, policy formulating organs, and health workers within E&S African regions and the rest of the world. It was also intended to join the efforts made by other individuals, groups of people and organizations that fight the pandemic in Africa. The following are some of the ways and areas in which the findings of this study can benefit both HIV/AIDS interest groups and persons interested in informetrics.

- Policy makers, e.g. World Health Organization (WHO), United Nations Development Program (UNDP), UNAIDS, etc., in their decision-making processes as pertains to research activities and funding HIV/AIDS research in E&S Africa. Systematic reviews of HIV/AIDS research findings, such as these, may play an important role in making available evidence from research in a usable form to policy-makers and practitioners. The study is intended to assist in policy formulation and decision making processes regarding promotions and tenure of researchers, donor funding, areas of research funding, research collaborative activities, etc.

- Pharmaceutical companies such as Hoffman La Roche, Glaxo Wellcome, and SmithKline Beecham may be assisted in prioritizing areas of research and financial support on biomedical research, and more specifically on HIV/AIDS research in Sub-Saharan Africa (see Onyancha & Ocholla, 2005).

- Collection development and management librarians with regard to their acquisitions and development activities. With current diminishing library budgets, worsened by the escalating prices of both print and electronic journals, it is important that librarians acquire core resources for their libraries.

This study may assist in identifying these resources, especially journals, on HIV/AIDS in sub-Saharan Africa and more particularly in E&S Africa.

- Journal publishers. A journal's impact, and hence the inclusion of it in key bibliographic databases, often has direct bearing on the quality of the journal. Citation analysis may assist publishers when re-examining factors that may lead or might have led to the low ranking or scientific impact of their journals. If publishers are made aware of their journals' low status, a re-evaluation of their journal management and article selection policies may become necessary.

- Database subscribers and journal subscribers and readers. Databases that index most core journals and a variety of other resources on HIV/AIDS are likely to receive more attention from librarians and other interested groups of people. Users who would want to use the contents of the journals for research purposes and/or researchers who seek to publish their research findings would normally evaluate the sources before making any decisions.

- Bibliometric/informetric/scientometric and HIV/AIDS researchers who have an interest in these research methods. This study is meant to popularize informetrics as a research tool as well as encourage further studies into HIV/AIDS and other human diseases such as cancer, malaria, tuberculosis, etc using the same research method, i.e. informetrics.

- Teachers interested in teaching bibliometrics/informetrics/scientometrics. Informetic studies are rare in Africa, and as such teachers will find this study particularly useful as a sample reference.

- Students who have an interest in bibliometrics/informetrics/ scientometerics. This study will serve as a reference tool for students of bibliometrics/informetrics/scientometrics.

- Institutions involved in HIV/AIDS research (e.g. Kenya Medical Research Institute - Kenya, University of Witwatersrand - South Africa, Muhimbili University – Tanzania, Medical Research Council – South Africa, etc.) may find this study a good reference source on the nature, types and trends of HIV/AIDS research in Africa.

- The study is also intended to be a contribution to the field of bibliometrics/ informetrics/scientometrics as far as research using these methods in research evaluation is concerned.

- The findings on the HIV/AIDS collaborators may assist researchers when identifying other researchers in different regions with whom they can collaborate or partner up in conducting research. Essentially, this study aims to encourage collaboration in HIV/AIDS research within different regions covered in this study.

- This study may also assist employers in the process of identifying suitable candidates for recruitment using the results on the most cited and productive authors.

1.7 Literature review approaches

According to Neuman (2000:445), literature review is "*based on the assumption that knowledge accumulates and that we learn from and build on what others have done*". It is defined by Hart in Chisenga (2004) as the selection of available documents (both published and unpublished) on a topic, which contain information, ideas, data and evidence written from a specific standpoint to fulfill certain aims or express certain views on the nature of the topic and how it is to be investigated, and the effective evaluation of these documents in relation to the research being proposed. The Swedish Council on Technology Assessment in Health Care (as cited in Baake, 2006) defines literature review as "*a summary and interpretation of research findings reported in the literature. [It] may include unstructured qualitative reviews by single authors as well as various systematic and quantitative procedures such as meta-analysis*". Literature to be reviewed may be empirical, theoretical or methodological. Neuman (2000:96) states that researchers review literature in order to:

- Demonstrate familiarity with a body of knowledge and establish credibility;

- Show the path of prior research and how a current project is linked to it;
- Integrate and summarize what is known in an area; and/or
- Learn from others and stimulate new ideas.

Literature regarding the nature, type and trends of productivity and scientific impact of HIV/AIDS research was reviewed from a number of resources, with particular emphasis being placed on electronic, print periodicals, and the Internet, as these sources provide current information. Other sources comprised of conference proceedings, government publications, theses and dissertations, and books, etc. Relevant literature was reviewed in various chapters depending on the focus areas of each chapter. For instance, Chapter Two provided literature reviews that discussed the conceptual and theoretical basis of informetrics, while Chapters Four to Seven (which simultaneously deal with data presentation, interpretation and discussion) also reviewed literature specific to the focus areas of the individual chapters as follows:

- Chapter four – Research collaboration
- Chapter five – Growth, productivity and the scientific impact of sources that publish HIV/AIDS literature;
- Chapter six – Producers (i.e. researchers, institutions and countries) of HIV/AIDS research
- Chapter seven – Subject content of HIV/AIDS research.

Literature review in Chapters four to seven was conducted in order to bring out the reasons and methods of evaluation as well as compare the aims, objectives, methodologies, findings, and the conclusions of previous studies with the current study. This, of course, is all in addition to using the reviewed literature to support this study.

1.8 Organization of the Thesis

The thesis comprises the following chapters:

Chapter One: Introduction and background of the study, which consists of: the introduction; background of the research problem; research problem; aim and research goals; hypotheses; motivation for the study; scope; limitations and delimitations of the study;

significance of the study; presentation of the literature review method; organization of the thesis; dissemination of the findings; and glossary.

Chapter Two:	Theoretical and conceptual setting, comprising: the scope of informetrics (including definitions of informetrics, bibliometrics, scientometrics, webometrics, and cybermetrics); Informetric measures; Informetric laws; models of informetrics; theoretical basis of informetrics; and the application of informetrics in Library and Information Science.
Chapter Three:	Research methodology presents the study area, target population, research instruments, data collection procedures, and data presentation and analysis approaches.
Chapter Four:	Entitled "collaboration in HIV/AIDS research in E&S Africa", Chapter four provides an overview of research collaboration, reviews previous studies, presents data, and discusses findings on the nature, type and trends of collaboration in HIV/AIDS research by analyzing co-authorship patterns.
Chapter Five:	Sources of HIV/AIDS information specific to E&S Africa. This chapter analyzes data and discusses the research findings under various headings such as the number of source publications published in E&S Africa, coverage in key bibliographic databases, document type, most productive sources, place of publication, most cited sources, and core sources of HIV/AIDS research.
Chapter Six:	Producers of HIV/AIDS research in E&S Africa. Using data from the authors' address field, this chapter identifies the most productive regional and foreign countries and institutions, the number of contributing countries, the most cited authors, and the most cited works, etc.

Chapter Seven: The subject content analysis of the HIV/AIDS literature on E&S Africa was conducted and presented in this chapter in order to compare research activities by various sub-fields of HIV/AIDS. The analysis and discussion focused on the yearly distribution of records, the yearly ranking of HIV infection, the yearly ranking of AIDS sub-headings, the most commonly used MESH terms in indexing HIV/AIDS literature, and the relatedness of opportunistic infections, risk factors, pre-disposing factors, sexually transmitted diseases and other tropical diseases to HIV/AIDS.

Chapter Eight: Chapter eight provided the summary, conclusions, and recommendations of the study.

1.9 Dissemination of the Findings

The means of disseminating the findings of this study will include:

- ❖ Presenting the results at conferences.
- ❖ Through seminars and workshops.
- ❖ Publishing the findings in refereed journals.
- ❖ Publishing the thesis.
- ❖ Availing copies of the thesis to libraries and other information providing centers.

It should be noted that part of this thesis has been reported at conferences and published in journals, e.g.

- Growth, productivity, and scientific impact of source publications of HIV/AIDS research in E&S Africa, 1980-2005. A Paper presented at the 9th Annual LIASA Conference, Pretoria, Gauteng, South Africa, 25-29 September 2006
- *Country-wise* collaborations in HIV/AIDS research in Kenya and South Africa, 1980-2005. A paper presented at the Fourth Biennial

DISSAnet Conference Pretoria, South Africa, 1 - 3 November 2006 (see www.dissanet.com)

1.10 Summary

This chapter establishes the basis for the evaluation of HIV/AIDS research. Summarily, the chapter provides an introduction and background to the study, the problem statement, research goals, objectives, motivation for the study; scope, limitations and delimitations of the study; significance or value of the study; literature review method approaches; and the means of disseminating the research findings.

In the Chapter, it was argued that due to the scope of the HIV/AIDS pandemic's negative social and economic impact, there is an urgent need for collaborations between social scientists, epidemiologists, medical doctors, physicians, scientists, health workers, etc in the fight against the disease, and specifically in rendering biosocial approaches in comprehensively understanding the epidemic. Several informetric studies on HIV/AIDS research have been conducted in the last decade in developed countries, thus assisting researchers, policy makers, and health workers in those countries to make appropriate decisions in the fight against the pandemic and other intervention programs. There are very few such analytical studies in sub-Saharan Africa, and this study was meant to partly fill that gap by examining the nature, type and trends in HIV/AIDS research collaboration, the sources that publish HIV/AIDS research on E&S Africa, the producers of HIV/AIDS research and the subject content of HIV/AIDS research.

Although it was meant to encompass all aspects of HIV/AIDS research evaluation as regards E&S Africa, the study did not cover Rwanda and Burundi which are commonly classified as Central African countries, Islands such as Madagascar and the Seychelles, unpublished sources of information, and any other publication that is not covered in the three databases used to extract data.

It is hoped that the findings of this study will benefit policy and decision makers, pharmaceutical companies, collection development librarians, journal and database publishers, authors, database and journal subscribers, bibliometricians/

informetricians, library and information scientists, and bio-medical practitioners, to name a few.

Data presentation and analysis, and discussion of the findings, are covered in Chapters four to seven. The next chapter – Chapter Two – provides the theoretical and conceptual setting of this study. The chapter provides the definitions and scope of informetrics and its related metric terms (methods), which include bibliometrics, scientometrics, webometrics and cybermetrics. The chapter also provides a description of the terms' inter-relationships, the theoretical basis of informetrics, and the application of informetrics (and its methods) to Library and Information Science (LIS).

CHAPTER TWO

THEORETICAL AND CONCEPTUAL SETTING

2.1. Introduction

Horby (2000:1241) provides three basic definitions of theory, thus:

1. A formal set of ideas intended to explain why something happens or exists.
2. The principles on which a particular subject is based; or
3. An opinion or idea that somebody believes is true but that has yet to be proven.

Neuman (2000) believes that a theory can be explained or defined by the framework of assumptions and concepts in which it is embedded, in addition to other aspects. He observes that there are several theoretical frameworks in the field of sociology. Neuman defines theoretical frameworks (sometimes known as paradigms or theoretical systems) as "*orientations or sweeping ways of looking at the social world*" (Neuman, 2000:59). The Center for Research on Education, Diversity & Excellence (2002) defines theoretical frameworks as basic conceptual structures organized around theories. Eisenhart (1991:205) describes a theoretical framework as "*a structure that guides research by relying on a formal theory...constructed by using an established, coherent explanation of certain phenomena and relationships*", for example Vygotsky's theory of socio-historical constructivism. Accordingly, Neuman states that theoretical frameworks are meant to provide collections of assumptions, concepts, and forms of explanation. Conceptual frameworks, on the other hand, are described by Eisenhart (1991:209) as "*a skeletal structure of justification, rather than a skeletal structure of explanation*" based on either formal logic or experience. The arguments presented in conceptual frameworks may provide differing views about the assumptions, concepts and explanations of a phenomenon.

Noting that "*bibliometrics has largely been used only to describe bibliographic phenomena, and is not yet able to explain or predict these phenomena,* [and thus] *it is merely a method, not a theory*" (Potter, 1981a:5), the researcher chose to dwell on both the theoretical and conceptual basis of informetrics. Specific conceptual considerations, e.g. research evaluation methods and reasons for conducting a research evaluation using various units (e.g. authors, journals, etc), are outlined in Chapters Four to Seven.

2.2 Scope of Informetrics

The following section:

1. Offers the definitions and scope of bibliometrics, scientometrics, webometrics, cybermetrics and informetrics.
2. Outlines the inter-relationships between these metric terms.

2.2.1 Definitions

2.2.1.1 Bibliometrics

The term bibliometrics was coined by Pritchard in 1969 upon observing that the previously used phrase, "statistical bibliography", was clumsy and lacked clarity. He defined Bibliometrics as the "*application of mathematical and statistical methods to books and other media of communication*" (Pritchard in Hertzel, 1987:153; Ikpaahindi, 1985:163). Potter (1981a:5) defines bibliometrics as the "*study and measurement of the publication patterns of all forms of written communication and their authors*". A number of researchers have defined bibliometrics in relation to their field of study or according to its incorporation in different disciplines. Accordingly, bibliometrics has been defined as:

- The use of mathematical and statistical methods in order to study the use of materials and services within a library, or to analyze the historical development of a specific body of literature, particularly its authorship, publication, and use (Reitz, 2002). According to the author, bibliometric analyses can be applied to library usage and to study the growth of literature by the number of authors, publications and usage. The former description of bibliometrics is termed *Librametry*, which Rao & Neelameghan (1992:243) define as the "*quantitative methods applied to library management and services*".
- The application of mathematical and statistical methods to the study of the use made of books and other media within and between library systems (Prytherch in Diodato, 1994).

- The application of mathematical and statistical methods to the measurement of quantitative and qualitative changes in collections of books and media (Ungern-Sternberg, 1995, Section 4, para. 3).
- The application of quantitative methods to the study of information resources (Wallace, 1989:10).
- A study that uses statistical and mathematical methods to analyze the literature of a discipline as it is patterned in its bibliographies (Standerfer, 1998).

2.2.1.2 Scientometrics

Scientometrics, on the other hand, is the "*mathematical and statistical analysis of research patterns in the life and physical sciences*" (Diodato, 1994:145). The term refers to methods that analyze the structure and development of science, scholarly communication, information seeking behavior and government policy as they relate to science. Spiegel-Rosing (in Diodato, 1994:146) believes scientometrics consist of methodologies that apply quantitative mathematical studies to science and technology. According to Hood & Wilson (2001), the term scientometrics is mainly used to study all aspects of the literature of science and technology. Thus it "*includes all quantitative aspects of the science of science, communication in science, and science policy*" (Hood & Wilson, 2001:293). Brusilovsky (as cited in Garfield, 1979:313) further defines scientometrics as "*the study of the measurement of scientific and technological progress*", while Malin (in Garfield, 1979:313) terms scientometrics as the "*science of science*". Garfield explains that scientometrics is concerned with the demographics of the global scientific community (Garfield, 1979:313).

2.2.1.3 Cybermetrics and webometrics

Cybermetrics and webometrics are the most recent metric terms incorporated into informetrics. Although some have argued that both cybermetrics and webometrics deal with analyses of the production, retrieval, and use of online information resources, there still exists confusion as to their definition. More often than not, the two terms are used interchangeably. Björneborn (in Björneborn & Ingwersen, 2004:1217) offers a clear distinction by defining, first, Webometrics as "*the study of the quantitative aspects of the construction and use of information resources, structures and technologies on the Web drawing on bibliometric and informetric approaches*". Webometrics is therefore the application of bibliometric methods to the

World Wide Web (WWW). In essence, webometrics is restricted to the study of patterns of information production, storage, searching, retrieval, dissemination and use on the WWW. In turn, the WWW refers to the portion of the Internet that uses text, images, sound, video and file transportation to provide information in the form of billions of web pages from around the world. It follows that some aspects of the internet, such as emails, listservs, forums, usenet news, infranet, intranet, etc, are not covered under webometrics, and categorized instead under cybermetrics. Cybermetrics is defined by Björneborn (as cited in Björneborn & Ingwersen, 2004:1217) as "*the study of the quantitative aspects of the construction and use of information resources, structures and technologies on the whole Internet drawing on bibliometric and informetric approaches*". Thus, Cybermetrics encompasses all webometric studies and includes the statistical studies of "*discussion groups, mailing lists, and other computer-mediated communication on the Internet*" (Björneborn & Ingwersen, 2004:1217).

2.2.1.4 Informetrics

Diodato (1994:ix) defines informetrics as methodologies that examine "*patterns that show up not only in publications but also in many aspects of life, as long as the patterns deal with information*". Informetrics is one of the most recent metric terms, and Hood & Wilson (2001:294) further observe that the term "*comes from the German term 'informetrie' and was first proposed in 1979 by Nacke to cover that part of information science dealing with the measurement of information phenomena and the application of mathematical methods to the discipline's problems, to bibliometrics and parts of information retrieval theory, and perhaps more widely*". According to Egghe & Rousseau (1990:1), informetrics deals with the measurement, mathematical theory and modeling of all aspects of information. The authors argue that informetrics largely "*borrows tools (techniques, models, analogues) from mathematics, physics, computer science and other metrics*". This is well explained in Fig 2.1.

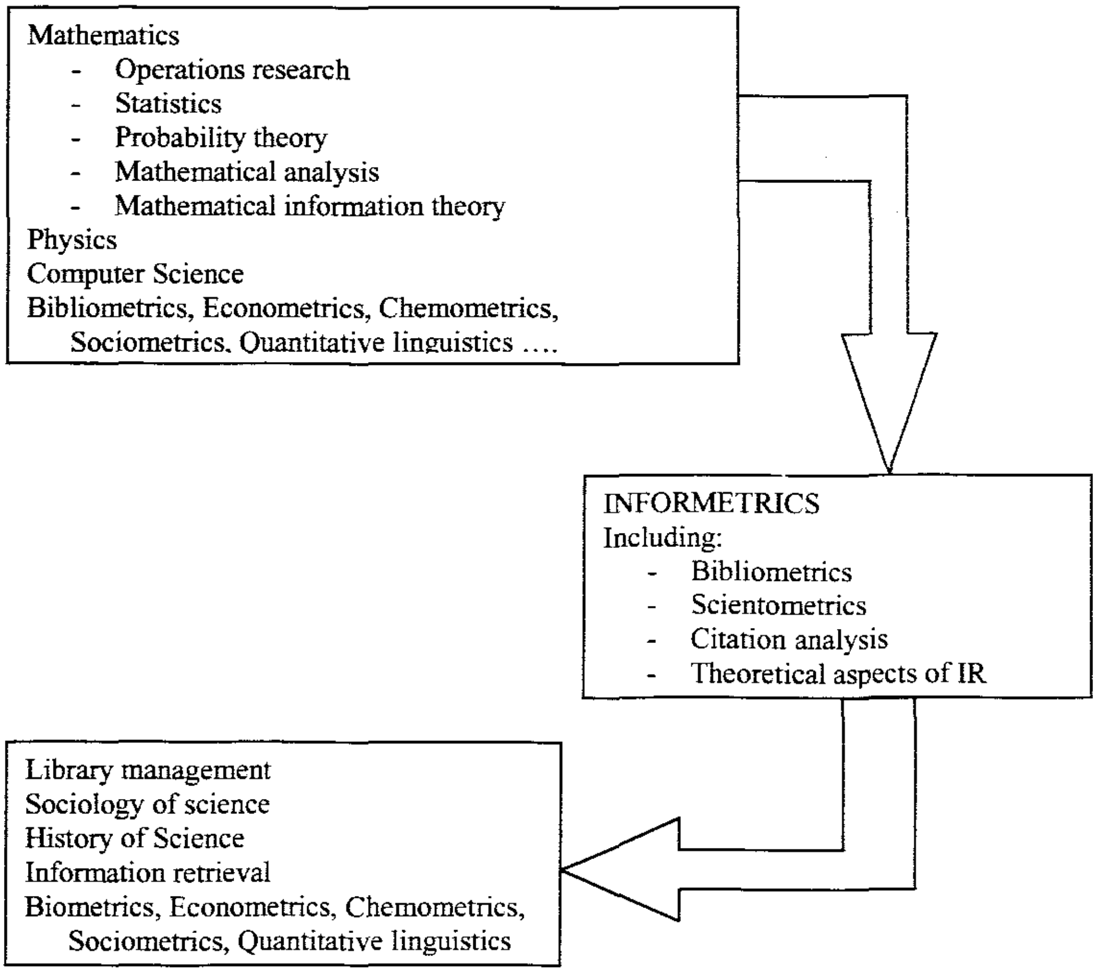

Fig 2.1: Informetrics relationship with other fields (*Source: Egghe & Rousseau, 1990:3*)

The diagram also indicates that informetrics is used and/or applied to library management, the sociology of science, history of science, information retrieval, and biometrics, econometrics, chemometrics, sociometrics, and quantitative linguistics, to name a few. A detailed description of the use of informetrics in Library and Information Science (LIS) is provided in section 2.5 of this Chapter. This study chose to use informetrics according to its status as one of the most widely used quantitative approaches when measuring research productivity and scientific impact, and its broad scope, upon comparing it with other related metric approaches. Its popularity is reflected in several studies that have recently proliferated, and the formation of the International Society for Scientometrics and Informetrics (ISSI), in addition to the publication of specialized journals in the subject domain (e.g. Journal of Cybermetrics

– the online journal of Scientometrics and Informetrics; Journal of Informetrics; and Scientometrics). These journals cover a wide range of papers on informetrics. In a study conducted by Hood & Wilson (2001) on *the literature of bibliometrics, scientometrics and informetrics*, the journal of *Scientometrics* was ranked first with 1197 records. Other journals that have exhibited strong support for informetric studies, according to Hood & Wilson's study, include the *Journal of the American Society for Information Science* [JASIST] (319), *Nauchno-Tekhnicheskaya ya Informatsiya series 1&2* (285), *Information Processing and Management* (128), *Journal of Information Science* (127) and *Journal of Documentation* (109), among others. All these attest to the popularity of informetrics as a means of measuring research productivity and scientific impact.

Worldwide, informetric studies have been reported in many fields of research, including biomedicine. The evaluation of the results of biomedical research, particularly various epidemic human diseases and other related subjects using publications count and citation analysis, is increasingly taking center stage in informetric research. Informetric studies have been conducted on subject areas such as Onchocerciasis (Afolabi, 1989), Cardio-vascular diseases (Rodrigues, Fonseca, & Chaimovich, 2000; Arunachalam & Gunasekaran, 2001) and general biomedicine (Lewison, 2001; Steynberg, &' Rossouw, 1995; Sodha, 1993). Others include cancer (Rodrigues, Fonseca, & Chaimovich, 2000), malaria (Rodrigues, Fonseca, & Chaimovich, 2000; Beattie, Renshaw & Davis, 1999; Lewison, Lipworth, de Francisco, n.d.; MacLean, Anderson, & Davis, 1997; Anderson, MacLean & Davis, 1996), and alternative medicine (Yitzhaki & Shahar, 2000).

2.2.2 Inter-relationships

From the above cited descriptions of informetrics, bibliometrics, scientometrics, webometrics, and cybermetrics, it is possible to see why lack of clarity reigns in the use of these terms, particularly the first three, i.e. bibliometrics, informetrics and scientometrics, a point observed by various writers (Wormell, 2001; Hood & Wilson, 2001; Sengupta, 1992; Wolfram, 2000; and Bookstein, 1990). Their definitions appear to contain a lot of overlap. The synonymous usage of these three terms is also implied by Ocholla (2003), who observes that both informetrics and bibliometrics study the distribution, circulation and user pattern of publications through the application of statistical methods. Diodato (1994:145) argues that "*some of scientometrics is simply bibliometrics applied to the sciences*" (Diodato, 1994:145). The use of these metric terms is further compounded with the inclusion of *Librametry (Librametrics)* and *Technometrics*. Authors such as Rao & Neelameghan (1992) treat bibliometrics and librametry as terms that refer to the same methods. They argue that bibliometrics and librametry may both be defined as areas in which one studies "*information processes and information handling in libraries and information centers by quantitatively analyzing the characteristics and behavior of documents, library staff and library users*" (Rao & Neelameghan, 1992:243). Standerfer (1998) suggests that bibliometrics is known by other names, such as scientific bibliography, informetrics or scientometrics, but is quick to add that there are subtle distinctions between these terms. However, the author does not provide these distinctions.

In differentiating informetrics from bibliometrics and scientometrics, Wolfram (2000) and Wormell (2000) consider bibliometrics and scientometrics to be older terms from which the term informetrics is derived (Wolfram, 2000; Wormell, 2000). Björneborn & Ingwersen (2004) offer a good description of the similarities and differences between the five metric terms. Their observations are graphically represented in Fig. 2.2.

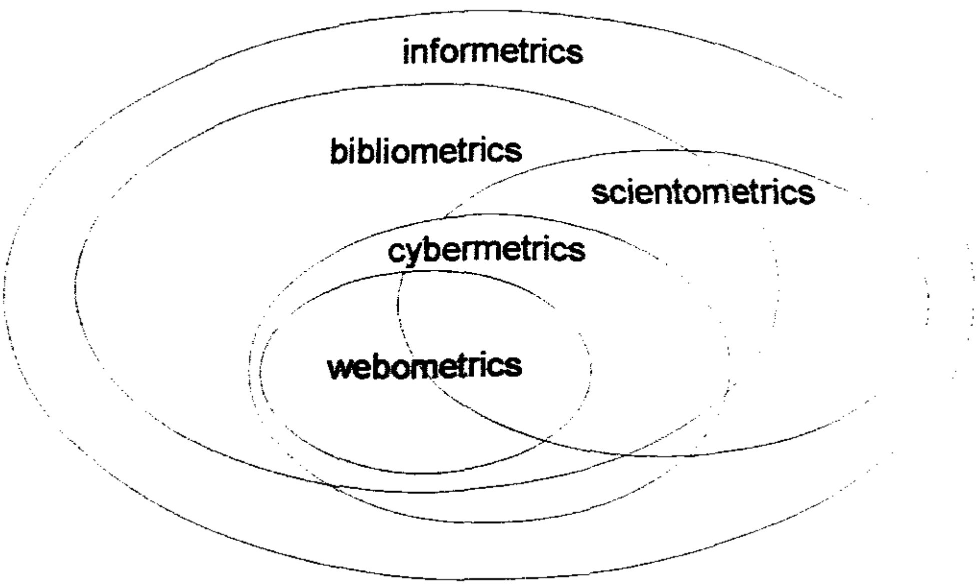

Fig 2.2: The sizes of the overlapping between Informetrics, bibliometrics, scientometrics, cybermetrics and Webometrics (Björneborn & Ingwersen, 2004).

Fig 2.2 presents a picture indicating the overlaps between informetrics, bibliometrics, scientometrics, cybermetrics and webometrics. The following can be deduced from the illustration:

- That all webometric studies are cybermetric, bibliometric and informetric in nature and some of the webometric studies are scientometric;
- Some cybermetric studies use bibliometric and scientometric approaches while they utilize all informetric methodologies;
- Scientometric studies are partly bibliometric and vise-versa, and all bibliometric and scientometric studies are informetric in nature;
- Finally, and most importantly, informetric studies can be webometric, cybermetric, scientometric or bibliometric in nature. That is, informetrics is a general term that covers webometrics, cybermetrics, bibliometrics, and scientometrics.

Björneborn & Ingwersen (2004) concur with Brookes in Wolfram (2000) that both bibliometrics and scientometrics are part of informetrics. Likewise, Egghe (2005) uses the term informetrics as a broad term consisting of all metrics studies related to information science, including bibliometrics (bibliographies, libraries etc.), scientometrics (science policy, citation analysis, research evaluation etc.), and webometrics (metrics of the web, the Internet or other social networks such as citation or collaboration networks). Consequently, bibliometric or scientometric applications, empirical regularities and theories, are actually informetric applications, empirical regularities and theories. Thus it may be argued that the key areas of study within informetrics would include classic bibliometric laws, citation and co-citation analysis, scientific indicators, information growth and obsolescence, and the use of document/information resources (Wolfram, 2000). Hence, the use of the term "informetrics" in this study conforms to the above, wherein it encompasses bibliometrics and scientometrics and their methodologies, although the term bibliometrics may be used occasionally in reference to informetrics whenever applicable.

2.3 Informetric measures of research

Informetric measures can be divided into descriptive and evaluative measures, commonly referred to respectively as production (publications) count and citation analysis.

2.3.1 Publications count

Publications count is used to study publication or research output in different countries, the amount produced during different periods, or the amount produced in different subdivisions of the field (Hertzel, 1987; Sengupta, 1992). Nicholas & Ritchie (1978) observe that studies using publications count normally describe the characteristics or features of literature. A study conducted on 4,000 researchers to identify appropriate bibliometric indicators for research performance measurement in their disciplines, found that publications (i.e. publication of research results in refereed journals) ranked as the most important performance indicator (Kostoff, 2001). Other performance indicators, according to the same study, include peer reviewed books, keynote addresses, conference proceedings, citation impact, chapters in books, and competitive grants.

According to Victoria (n.d.), publications count is the simplest informetric measurement. Hence at its simplest, publications count involves counting the number of papers, citations, references, patent citations, words within a text, books and other writings in the field, or often by a count of those writings which have been abstracted in a specialized abstracting journal. Such counts provide a general view of the production activity in a field, institution or company, as well as highlight an individual's performance.

Examples of questions that publications count is designed to answer are:

1. How many publications, citations, books, patents, etc has a particular author, group of authors, institutions and/or countries/geographic regions. produced?
2. How much has been produced on a given topical issue, discipline, country, regional area, etc?
3. How many publications have each been authored by how many authors?
4. How many publications were published in a given source (journal, magazine, etc?)

5. In how many languages are documents published?
6. How often does a particular word appear in a text?

Results from such analyzes may then be used to measure and compare research productivity and collaboration among authors, institutions, journals, and countries/regional areas, to name a few. Measuring collaboration involves counting the number of authors publishing a single paper. A detailed discussion of research collaboration is offered in Chapter Four.

Although commonly applied in assessing research output, publications count should be used cautiously, particularly when used as a proxy of research productivity because of the limitations associated with it. Objections have been raised in the following areas as outlined in King (1987:262) and Kostoff (2001, Section IV-B-5-ii, para. 1):

1. Publications count does not provide any indication as to the quality of the work performed
2. Informal and formal non-journal methods of communication in science are ignored
3. Publication practices vary across fields and between journals
4. Social and political pressures on a group to publish vary according to country, to the publication practices of the employing institution, and to the emphasis placed on number of publications for obtaining tenure, promotion, grants etc.
5. The choice of the right database is problematic and therefore makes it very difficult to retrieve all the papers for a particular field.
6. An awareness of the use of publications count for assessment may encourage undesirable publishing practices such as the production of very brief papers.
7. Very few active researchers produce heavily cited papers
8. Biases favoring publications of established authors

Despite all these shortcomings, publications count still remains a valuable tool for information and other social scientists interested in measuring research productivity. A few, if not all, of the aforementioned drawbacks in the use of publications count could, however, be resolved if the method was used together with citation analysis.

2.3.2 *Citation analysis*

Citation analysis is one of the research areas of bibliometrics. A citation is defined as an "*acknowledgement that one document receives from another*" (Smith, 1981:83). This term is often used synonymously with "reference". There is, however, a difference between the two terms. According to Smith (1981:83), a "reference" is the "*acknowledgement that one document gives to another*". In order to clearly appreciate their difference, Diodato's (1984:32) explanation is paraphrased below, thus:

> Assume that document A appears in the footnotes (or bibliography or references) of document B. It follows therefore that:
>
> Document B gives document A as a reference;
> Document B refers to document A;
> Document B cites document A;
>
> and that:
>
> Document A receives a citation from document B;
> Document A receives a reference from Document B;
> Document A is cited by document B.

This therefore means that document A was published before document B in order for document B to refer to document A. In compiling document B, its author(s) make/s use of document A and subsequently give it an acknowledgement, implying therefore that document A is receiving an acknowledgement from document B. It is this latter acknowledgement that is called a citation. Hence, it can be concluded that either parts or the whole of the two documents are related in a way. The study of this relationship is what is known as citation analysis.

Citation analysis involves counting the number of citations, using a citations index, to a particular paper for a period of years after its publication (Hertzel, 1987). Citation-based indicators include the citation age, citation factor, cited half life, citing half life, citation behavior, biased citation, citation type, consumption factor, citation rate, citation density, citation impact, citation factor, citation frequency, and citation function, etc. while citation-based measurement techniques include co-citation analysis, and bibliographic coupling. Citation-based studies may focus not only on the documents, but also the authors, sources in which the documents are contained (i.e. journals, books, magazines, databases, web pages, etc), the organizations or countries in which the documents are produced, and the purpose of the citations (Diodato, 1994:33). In specific terms, Wallace (1989:18) demonstrates that the focus areas of citation studies would include:

1. what motivates an author to cite a particular work;
2. the relationship between a citing work and the works cited by it;
3. works cited long after their publication and works cited while relatively new;
4. heavily cited works, infrequently cited works and those that have not been cited at all;
5. how citation practices and patterns differ throughout disciplines or families of disciplines;
6. how citation practices and patterns can be used in the evaluation of information sources;
7. how citation practices and patterns can be used to enhance information retrieval systems.

He further enumerates the fundamental assumptions associated with citation studies, namely:

1. That the citing author has actually used the cited work and has cited all works used;
2. That the citation of an information source is an indicator of its quality;
3. That the citing author has provided references to the best possible works;
4. That the content of the citing work is significantly related to the content of the cited works; and
5. That all citations are of equal value (Wallace, 1989:18)

It is in these assumptions that many have found faults with citation analysis. Above all, these assumptions are not universally true, although they may be true under given circumstances (Wallace, 1989). Secondly, there are several factors that motivate authors to cite others, some of which include the following:

1. a desire to give the appearance of being in touch with the most recent literature;
2. the need to provide support for a methodology or tool;
3. attempts to persuade the reader of the correctness and importance of the ideas presented in the study;
4. providing appropriate credit for the origins of ideas;
5. alerting the reader to important publications;
6. establishing evidence of a consensus of opinion amongst researchers; and
7. refuting the claims of other researchers (Wallace, 1989:18-19; King, 1987)

While agreeing with Wallace(1989), Cronin (in King, 1987:96) outlines 10 different reasons for citing, which include 'hat-tipping', over-elaborate reporting, and citing the most popular research trends in order to carry favor with editors, or grant-awarding bodies, etc" (King, 1987:263). Turnbull (2000) and Garfield (in Smith, 1981:84) provide a fairly comprehensive list of reasons why authors cite others, e.g. paying homage to pioneers; giving credit for related work; identifying methodology, equipment, etc; background reading; correcting one's own work; correcting the work of others; criticizing previous work; substantiating claims; alerting others to forthcoming work; providing leads to poorly disseminated, poorly indexed, or un-cited work; authenticating data and classes of fact-physical constants, etc; identifying original publications in which an idea or concept was discussed; identifying an original publication or other work describing an eponymic concept or term; disclaiming the work or ideas of others; and disputing the priority claims of others. King (1987) observes that a work that is incorrect tends to be highly cited; methodological papers similarly attract numerous citations; and self citations, more often than not, inflate citation rates. Other limitations of citation analysis include those associated with the databases used to collect data, and field-dependant factors.

These drawbacks notwithstanding, Cronin (in King, 1987) considers citation analysis to be a useful analytic tool given that citations give substantive expression to the process of innovation, and, if properly marshaled, potentially provide the researcher with a forensic tool of seductive power and versability. Wallace (1989:19) also observes that the "*notion that citation represents a rather constant indication of the relationship between one information source and another lies at the heart of most* *citation studies, and plays a key role in the practical application of citation analysis*". Nevertheless, even with its wide application in evaluative studies, Wallace (1989) advises that citation analysis should be treated with caution. His argument first lies in the fact that an author's contribution to a field is likely to be misjudged given that it is not easy to obtain all his/her publications. Secondly, citation counts represent only citations from journals covered in citation indexes. Furthermore, errors may accrue from assigning individual authors' citation counts, given that citation indexes provide only the author's last name and initials, and are subject to virtually no authority control. Finally, Wallace warns that "*the uneducated use of citation counts for evaluative purposes of any kind can have disastrous results, and a very real problem of citation analysis is application of results by individuals who are not capable of effectively interpreting them*" (Wallace, 1989:19).

2.4 Theoretical basis of Informetrics

This section outlines the theoretical basis of informetrics by providing a description of three empirical laws and models of bibliometrics, as well as a review of the attempts that have been made towards the development of a general bibliometric theory.

2.4.1 Informetric laws

Ikpaahindi (1985:169) defines informetric laws as "*statistical expressions which seek to describe the working of science by mathematical means*". According to Diodato (1994:99), informetric laws are "*descriptions or hypotheses about patterns that seem to be common in the publication and use of information*". He enumerates the widely known laws of informetrics, which include Booth's, Bradford's, Brooke's, Estroup's, Leimkuhler's, Lotka's, Pareto's, Price's, Willis', and Zipf's laws. Of all these laws, only three are commonly used in bibliometric studies (particularly as they relate to LIS), notably, Bradford's law of scattering, Lotka's inverse square law of author productivity, and Zipf's law of word frequency in a text.

2.4.1.1 Bradford's law

Samuel C. Bradford (1878-1948) is well known for his empirical study on the scatter of relevant articles withinin a subject domain in source publications. He started off by noticing that indexers and abstracters could miss up to 67% of published journal articles each year, leading to engineers and scientists missing highly important information. In the words of Kellerman (1997:8), Bradford was concerned that "*scientists and engineers were missing important information because the abstracting and indexing services could not include every journal that might have articles of possible relevance*". He attributed this anomaly to the manner in which literature on a given subject field is distributed among the periodicals.

While practicing as a librarian in the Science Museum in London, Bradford founded what has probably become the most commonly used bibliometric law – Bradford's law of scatter. In his study, conducted in 1934 on geophysics, Bradford analyzed 326 journals and discovered that 9 journals contained 429 articles, 59 contained 499 articles, and 258 contained 404 articles. Upon ranking the journals according to the number of records, Bradford noticed that it took 9 journals to contribute one-third of the articles, 45 to produce the next third, and 225 to produce the final third. He concluded that journals in any field could be divided into three zones, each containing the same number of articles, as follows:

> Zone one: a core of journals on the subject, relatively few in number, that produce approximately one-third of all the articles
>
> Zone two: containing the same number of articles as the first, but a greater number of journals, and
>
> Zone three: containing the same number of articles as the second, but a still greater number of journals (Palmquist, 2001).

Bradford's law simply states that:

> "*If scientific journals are arranged in order of decreasing productivity of articles on a given subject, they may be divided into a nucleus of periodicals more particularly devoted to the subject and several groups or zones containing the same number of articles as the nucleus, when the number of periodicals in the nucleus and succeeding zones will be as* $1: k: k^2$ where the constant k is known as Bradford's constant or multiplier (Ungern-Sternberg, 2000)

In his study, Bradford discovered a regularity that can be used to calculate the number of titles in each of the three zones. He observed thus:

Zone one: 9 titles

Zone two: 9 x 5 titles (i.e. 45 titles)

Zone three: 9 x 5 x 5 titles (i.e. 225 titles).

This distribution of journal titles could be expressed as:

$$9: 9 \times 5: 9 \times 5 \times 5 = 9: 9 \text{ xs } 5^1: 9 \times 5^2$$

Simplifying this relationship further, we divide by 9 (since this core may differ from one study to the next), resulting in a relationship of $1:5:5^2$. However, since the multiplier (i.e. 5) may also be different across different disciplines, it can be replaced with the letter n, hence Bradford's formula: $1:n:n^2:\ldots..$

Notably, the above analysis of the number of journal titles in each group does not yield or is not the same as Bradford's empirical findings (i.e. zone 1 = 9 titles, zone 2 = 59 titles and zone 3 = 258 titles), although it can be said to be close. Furthermore, some writers (e.g. Drott, 1981) have noted that Bradford did not give any mathematical model for his law, hence the different modifications and explanations by various writers (e.g. Vickery, 1948; Brookes, 1968, 1969). Drott (1981) also notes that there are gaps in Bradford's law, especially in its theoretical development. For instance, he poses the question, "*what is the nature of the underlying probabilistic events which aggravate to create the regular pattern of dispersion of articles over titles?*" (Drott, 1981:42). This problem still remains unsolved.

These drawbacks notwithstanding, the application of Bradford's law in the management of library collections and databases (e.g. the SCI, SSCI, A&HCI, etc) is extensive and wide. According to Palmquist (2001: Bradford's law), "*Bradford's Law serves as a general guideline to librarians in determining the number of core journals in any given field*". Bradord's law is useful to the planners of indexing and abstracting services and to librarians developing collections. It has proven useful to many librarians in determining how extensive a collection should be in relation to instructional and research needs. The Law is also useful to writers and bibliographers (Standerfer, 1998).

Although a Bradford analysis of HIV/AIDS literature has yet to be conducted, there are numerous instances in which Bradford's Law has been used to rank journals (e.g. Ravi, 2001: Onyancha & Ocholla, 2004a). In Ravi's (2001) study on nuclear research in India, three zones were identified according to Bradford's analysis, with zone one (2 journals) contributing 4731 (34.42%) papers, while zones two (19 journals) and three (528 journals), recorded 4549 (33.09%) and 4466 (32.49%) papers, respectively. Onyancha & Ocholla's (2004a) findings on corruption literature also conformed to Bradford's pattern of dispersion. The authors found that "*a few journals published a relatively high percentage of articles on corruption, while many published one article each*" (Onyancha & Ocholla, 2004a:96).

2.4.1.2 Lotka's Law of Author Productivity

In 1926, Alfred J. Lotka (1880-1949), an insurance company statistician (Ikipaahindi, 1985), and a man who has since been credited with founding the mathematical pattern known as Lotka's law (Lotka's inverse square law), studied author productivity in Chemistry and Physics and noted that "*there are a few researchers who publish a great deal and many who publish very little or nothing at all*" (Ikipaahindi, 1985:171). Lotka observed that:

> "*for any body of literature, there will be a substantial number of authors who have each contributed only one publication, a smaller number of authors who have each contributed a small number of publications, and a very small group of authors who have each contributed a substantial number of publications*" (Wallace, 1989:10).

The mathematical expression states that in any given field, the proportion of authors making a contribution of one article or publication each out of the total number of publications is 60% (0.60) (Rao, 1983; Ikpaahindi, 1985). Ikipaahindi (1985:171) expresses the formula thus: "*the productivity of scientists adhered to an inverse square law such that for every 100 authors contributing one article, 25 will contribute two articles, about 11 will contribute 3 articles and 6 will contribute 4 articles*".

Therefore, as Diodato (1994:105) explains, "*there is an inverse relation between the number of documents produced and the number of authors producing the documents*".

Lotka's mathematical expression on scientific productivity has been commonly presented as $1{:}n^2$ where n is the amount of contributions, i.e. 2, 3, 4 articles that authors have made. As such, if the total number of contributions is 1200 articles, those authors making one contribution each will be 60% of 1200 (or 1920). Those producing two articles each will therefore equal $1/n^2$ of 720 (i.e. $1/2^2$ of 720 or ¼ of 720), which translates to 420 scientists.

Lotka's formula has been expressed in different forms, sometimes with improvement, such as the following:

1. $f(x) = k\,x^{-b}$; $x = 1, 2, \ldots\ldots x_{max}$; $k>0$, $b>1$,
   "*Where f (x) represents the probability of an author publishing x times in the subject area, x_{max} represents the maximum size or value of the productivity value x, and k and b are parameters to be estimated*" (Nicholls, 1989).

2. $x^n y = c$

Where y is the portion of authors making x contributions each, n and c are parameters that depend on the field being analyzed.

Since its inception in 1926, Lotka's Law has generated much interest among scientists from disciplines other than chemistry and physics, whose bibliographical data was used by Lotka. The Law has been applied to studies in humanities, library science, geography, anthropology, and in the field of Science by Murphy, Schorr, Aiyepeku Rogge, and Rodhakrishnan and Kernisen, respectively (as cited in Ikipaahindi, 1985). Potter (1981b) extensively reviews studies that have discussed Lotka's law, beginning with Dresden whose study, conducted in 1922, is believed to be the first. Other studies have attempted to cite or test the applicability of Lotka's law and these, as reviewed in Potter (1981b), include Dufrenoy, Davis, Williams, Zipf, Leavens, Simon, Price, and Fairthorne.

Potter (1981b:21) notes that despite the fact that Lotka's law was formulated in 1926, Lotka's article "*was not cited until 1941; his distribution was not termed 'Lotka's law' until 1949; and no attempts were made to test the applicability of Lotka's law to other disciplines until 1973*". Potter (1981b) argues that many scientists who have set out to test the applicability of Lotka's law in various disciplines have done so without proper understanding. He claims that "*it appears that some misunderstandings have developed, for, in fact most of the studies cited as demonstrating Lotkas law do not mention Lotka and do not offer comparable data*" (Potter, 1981b:25). Upon reviewing literature on Lotka's law, Potter (1981b) concludes that Lotka's law does not apply to a number of disciplines. His views are supported by the studies of Eurnham, Shearer and Wall, (as cited in Diodato, 1994:108), Pao (1986), Coile (1977), Ravi (2001), (Afolabi, 1989), Tsay & Yu (2002), and Onyancha & Ocholla (2004a). Burnham, Shearer and Wall, (in Diodato, 1994:108) noted that approximately 94% of the authors wrote no more than one or two articles, while Pao (1986) observed that most of the data he used to test Lotka's law did not fit the inverse square law. Coile (1977) further maintained that contrary to several writers' beliefs, Lotka's law does not actually apply to the fields of humanities and to the mapping of librarianship. Ravi (2001) also found that Lotka's law does not apply to nuclear science literature, while Afolabi (1989) and Tsay & Yu (2002), noted that the law does not apply to the psychological literature of Africa, and the indexing and abstracting of literature, respectively.

Potter (1981b:23), while acknowledging that Lotka's law elicits strong appeal in that its distribution is 'hard and fast', nevertheless faults the law's lack of precise statistical distribution. Palmquist (2001) concurs with Potter (1981b) by observing that Lotka's law is accurate when applied to large bodies of literature over a long period of time, but is not statistically exact. However, one of the law's most serious shortcomings relates to the lack of causal factors in Lotka's distribution. For instance, as O'Connor & Voos (1981:12) argue, the law "*does not explain why one individual produces dozens of published papers on a subject, another individual produces several papers, and a third individual produces none*". Perhaps this would suggest an area in need of extensive further research – i.e., examining the reasons for Lotka's distribution pattern of author productivity.

2.4.1.3 Zipf's Law

Zipf's Law is the least used of the three empirical laws of informetrics. Named after the philologist George Kingsley (1902-1950), the law is based on the fact that people tend to use a "*small part of their available vocabulary for most communication*" (Wallace, 1989). The law relies on the occurrence of words in a long text. According to Diodato (1994), Zipf's law is expressed in two ways. Zipf's first law concerns words of high frequency, while Zipf's second law holds for words with low frequencies. Zipf's first law conforms to the formula $C = r*f$ - where C is a constant, r is the rank of the word and f is the frequency- while his second law is expressed in the formula $N(f^2 - ¼) = C$; where N is the number of words that occur f times each, and C is a parameter that depends on the text being analyzed. Booth (as cited in Diodato, 1994:168) expresses Zipf's second law as follows:

$$I_n / I_1 = 3 / (4n_2 - 1)$$

Where I_n is the number of words that occur n times each, and I_1 is the number of words that occur once each.

In his description of Zipf's law, Potter (as cited in Palmquist, 2001, Zipf's Law section, para. 1) explains that if one "*lists the words occurring within a text in order of decreasing frequency, the rank **r** of a word on that list multiplied by its frequency **f** will equal a constant **C***". Zipf's law thus "*approximates the relationship between rank r and the frequency f for any actual corpus*" and works well for the middle ranks whose corpus should consist of at "*least 5000 words in order for the product rf to be reasonably constant, even in the middle ranks*" (Wyllys, 1981:55). Several attempts have been made to provide rationales for the Zipf phenomenon (e.g. Herdan, Hill & Woodroofe, Ijiri, Simon, Brookes, Fairthorne, etc as cited in Wyllys 1981:60-62). In his conclusion, Wyllys (1981:63) observed that the implications of Zipf's law for the design of information systems are few, if any. According to the writer, Zipf's law "*offers no useful information beyond what frequency-counts alone can easily supply*" (Wyllys, 63), which perhaps explains why it has received little attention from LIS researchers.

2.4.2 Informetric/bibliometric models

Diodato (1994:114) describes a model as an "*ideal description of an activity*" which, in informetrics, is "*usually expressed as a mathematical formula, although some models can be expressed graphically or verbally*". Diodato (1994:115) observes that the term model is sometimes synonymously used with terms such as cumulative distribution function, frequency distribution, frequency distribution function, probability distribution, mathematical function or simply distribution or function, in which case, notes Diodato, a model refers to a theoretical expression of a bibliometric law. Bradford's law, Lotka's law and Zipf's law are examples of bibliometric models. These models have been modified, extended, clarified, applied and generalized by a number of writers, years after they were first formulated. As Hubert (1981:65) clarifies, most informetric/bibliometric models relate, in a simple functional form, one variable to another. Therefore Bradford's law relates the number of journals to the number of articles (citations), while Lotka's law's relational variables are the number of authors and the number of publications. Examples of observation-class relationships, whose enormous literature offers several models, include: the number of citations and persons; length of word and words; number of occurrences and initial digits; checked-out frequencies and books; number of occurrences and words; length of sentence and sentences, etc. The models associated with the above relationships can be classified into two broad categories, namely, frequency-size and frequency-rank approach models. Hubert (1981) enumerates 28 articles containing models applicable to informetric/bibliometric phenomena. The most outstanding of these are three general informetric/bibliometric models, i.e. Price's model of cumulative advantage distribution, Bookstein's model of author productivity and Brookes' mixed Poisson model. Price's model is briefly discussed in section 2.4.3.

2.4.3 Informetrics theory

The development of these models was for the purposes of formulating an informetrics theory. Although there are instances when some of these models have been referred to as theories (Wallace 1989), a number of writers hold the view that bibliometrics still does not have a unified theory. For instance, Wallace (1989) points out that "*a potential limitation of bibliometrics and citation analysis is the lack of a well-developed unified theoretical base to explain and predict the patterns that have been* *observed*". A similar opinion was voiced by O'Connor & Voos (1981). The authors observed that bibliometrics is still used as a research method and not as a theory.

This perceived lack of a bibliometric theory has continued to plague LIS research for decades now. There have been attempts, such as those outlined in subsections 2.4.1 and 2.4.2, to provide a unified theory of informetrics. Another such proposal, offering a general explanation for bibliomeric distributions, is Derek De Solla Price's model of Cumulative Advantage theory. Developed in 1976, the function stipulates that "*if $f(n)$ is the fraction of contributors having n articles each, then $f(n) = (m + 1) B(n, m + 2)$, for $n = 1, 2, \ldots,$ with the parameter $m > 0$, and $B(\bullet, \bullet)$ is the Beta function*" (Hubert, 1981:69). The model is used to obtain the "*frequency or proportion of authors each of whom has produced a fixed number of articles on a specific area over a fixed period of time*". The same also applies to citation analysis. Price (1976) based his model on the principle of Matthew, commonly referred to as the "Matthew Principle", introduced by Merton in 1968 (Merton, 1988:606). The Principle is so-named because it is drawn from the Bible's Book of Matthew, Chapter 13 verse 12, which states that:

> *For whosoever hath, to him shall be given, and he shall have more abundance; but whosoever hath not, from him shall be taken away even that he hath"* (The Holy Bible. King James Version, 1979)

Christ's parable was meant to teach his disciples the necessity of desiring to have more truth about the word of God. Those who have made practical use of the truth revealed to them would be given more truth; while those who seem to have some perception of the truth, but neglect to improve what little capacity they may have, would lose even that little capacity (Nichol, 1979). In his interpretation of this principle, Price (1976:292) opines that:

> *"It is common in bibliometric matters and in many diverse social phenomena, that success breeds success. A paper which has been cited many times is more likely to be cited again than one which has been cited little. An author of many papers is more likely to publish again than one who has been less prolific. A journal which has been frequently consulted for some purpose is more likely to be turned to again than one of the previously infrequent use. Words become common or remain rare. A millionaire gets extra income faster and easier than a beggar".*

The cumulative advantage theory assumes that all units of analysis (journals, persons, species, words, authors, books, and nouns) have an equal probability of use. However, it has been observed that many circumstances dictate productivity and usage, for example author productivity is influenced by factors such as the author's personal characteristics and/or the author's environment or situation. In his explanation of the cumulative advantage principle, Wallace (1989) observed that a frequently used entity has a higher likelihood of being used again when compared to an infrequently used entity. Going by the number of papers that have cited Price's paper on cumulative advantage theory (e.g. Bazeley, 1998; Bensman, 1985; Bookstein, 1990; Wallace, 1989; Huber, 1998; Keller, 2005; Lawani, 1987; O'Connor & Voos, 1981; Drott, 1981; Wyllys, 1981; Hubert, 1981; etc), the theory's popularity cannot be overemphasized. Although some have criticized the "*quibbles regarding the exact formulation of equations related to the theory*" (Wallace, 1989:20), none have rejected the theory itself.

Finally, in their conclusion concerning the search for a bibliometric theory, O'Connor & Voos (1981:18) advise thus:

> *"It is unlikely that research results would ever be generalized beyond the unit of analysis. It could prove impossible to generalize a common theory from studies of individuals and studies of journals. At best, two middle-range theories might be developed which could suggest hypotheses for a single, third area of investigation.... The continued emphasis on the similarities of the bibliometric statistical distributions is not regarded here as a fruitful endeavor. The long-term benefits of bibliometrics will begin to emerge when attention is directed toward causal explanations of bibliographic phenomena. At that point, bibliometrics will again offer practical benefits to libraries".*

2.5 Informetrics applications in Library and Information Science

In general terms, informetrics (and its various approaches, measurements, methodologies, models, laws, etc.) can be used in the formulation of policies (e.g. assessing how well particular countries/institutions and even individuals are doing in research); library management and planning (e.g. identifying core literature, etc.); source assessment (e.g. what is the impact of a particular journal/conference/scientific event, etc?); tracking the history of science (e.g. how did a particular field develop?); and studying the sociology of science (e.g. who is working with whom in the invisible college?) (Victoria, n.d.). A field of study that has extensively applied informetrics techniques is Library and Information Science (LIS). In LIS research, informetrics is used for the following purposes (Sengupta, 1992:75-98; Wallace, 1989):

a) Evaluating studies for research funding and training programs
b) Identifying research trends and the growth of knowledge in different scientific disciplines
c) Estimating the comprehensiveness of secondary periodicals
d) Identifying the uses of different subjects
e) Identifying authorship and its trends in documents on various subjects
f) Measuring the usefulness of ad hoc and retrospective SDI services
g) Forecasting past, present and future publishing trends
h) Developing experimental models that correlate or bypass the existing ones
i) Identifying core periodicals in different disciplines
j) Formulating an accurate need-based acquisition policy within a limited budgetary provision
k) Adapting an accurate weeding and stacking policy
l) Initiating effective multilevel network systems
m) Regulating inflow of information and communication
n) Studying obsolescence and dispersing scientific literature (clustering and coupling of scientific papers, etc)
o) Indexing, abstracting and collection development

Smith (1981) provides a detailed description of the application of informetrics, specifically citations count and analysis in LIS. He observes that there are two themes constantly reflected in the use of citation analysis, i.e. the use of citations as tools for the librarian, and the use of citations as tools to analyze research activity. These two themes, according to Smith (1981:94-98), cover:

1. *"Literature of" studies,* in which one looks at citations in a particular subject area to describe patterns of citation.
2. *"Type of literature" studies,* in which citation analysis is used to gauge the dissemination of results reported in certain types of literature, such as

government documents, dissertations, or the exchange of literature of regional scientific societies.

3. *User studies,* whereby one investigates the use of library materials through (i) an analysis of references in works written by library users, or (ii) comparing user behavior in different time periods.
4. *Historical studies,* in which citation analysis is used to trace the chronology of events, [relationships among them], and their relative importance.
5. *Communication patterns,* where citations are used to analyze patterns of communication in order to identify problem areas within communication.
6. *Evaluative bibliometrics* in which citation analysis is defined as the evaluation and interpretation of the citations received by articles, scientists, universities, countries, and other aggregates of scientific activity, used as a measure of scientific influence and productivity.
7. *Information retrieval.* Here, citation analysis is used to augment traditional approaches to literature searching, e.g. in supplementing keywords while identifying relevant documents.
8. *Collection development,* a key area of library management that utilizes bibliometric/informetric techniques. Here, citation analysis is applied to the development of journal collections, where decisions to be made include:
    i. Whether or not to acquire a particular title
    ii. Whether or not to continue a subscription
    iii. Whether or not to weed a backset

There are other areas in LIS where informetrics can be applied. However, due to time and space constraints, the study has had to limit its inclusions to a few. Summarily, Wormell (2001) defines the field of Bibliometrics today as inclusive of all quantitative aspects and models of scienctific communication, storage and dissemination, and the retrieval of scientific information. This definition of the scope of bibliometric/informetric research areas is much wider than most and integrates all presently existing orientations, such as applications to science policy, library science, and information retrieval. The author further observes that informetric/bibliometrics can be used by three different groups of people categories, namely, bibliometricians, scientific disciplines, and science policy and business.

2.6 Summary

The purpose of this chapter was to provide the theoretical and conceptual basis of informetrics, the research method used to conduct this study. From the outset, it should be noted that the amount of literature pertaining to the theory of bibliometrics is enormous, and not all aspects of the theoretical basis of informetrics could be reviewed in this Chapter [due to time constraints]. Aspects such as co-citation analysis, bibliographic coupling, some bibliometric laws, and many others have not been covered here. The Chapter was limited to those aspects of informetrics that were pertinent to the whole study.

The literature review revealed that lack of clarity reigns in the use of the terms bibliometrics, scientometrics, and informetrics. These terms are often used synonymously or interchangeably, despite there being apparent and significant differences in their interpretation. While bibliometrics uses mathematical and statistical applications to analyze the literature of a discipline as it is patterned in its bibliographies, scientometrics is the application of bibliometric methodologies in science and technology, a definition that gives scientometrics a more specialized connotation. Informetrics, on the other hand, encompasses both scientometrics and bibliometrics, and is defined by the methodologies that examine patterns that show up not only in publications, but also in many aspects of life, as long as the said patterns deal with information. It consists of methodologies that can be classified under two broad categories, namely, descriptive and evaluative methodologies. These categories are respectively referred to as publications count and citations analysis.

Publications count is a descriptive quantitative research method that relies on the counting of papers, patents, patent citations, etc. in order to measure the research productivity of individual authors, sources that publish research papers, countries in which the publications are published, and the institutions behind the production of these papers/documents. The method has been extensively used to map and visualize research in different fields/disciplines. Nevertheless, great caution must be exercised when interpreting the collected data and drawing conclusions based on the findings because publications count, like many other research methods, has it weaknesses.

Citations analysis, on the other hand, is an evaluative informetric research method that makes use of the citations to and from documents in order to study the relationships between them. A citation implies that there exists a relationship between a part or whole of the cited publication and a part or whole of the citing document. Citation analyses assume that the: citing author has actually used the cited work and has cited all works used; citation of an information source is an indicator of its quality; citing author has provided references to the best possible works; content of the citing work is significantly related to the content of the cited works; and that all citations are of equal value (Wallace, 1989:18). It is in these assumptions that scholars have faulted the use of citation analysis in evaluating scientific influence and productivity. Given the many weaknesses associated with citation analysis, it is advised that results from such analyses be well understood, interpreted and cautiously used. For informetric analyses to be of any significant value in policy formulations and decision-making processes, this study has attempted to combine the two methods (publications count and citation analysis) in order to minimize the weaknesses associated with each of the methods when used individually. Most previously conducted informetric studies have largely been limited to the use of either of the two methods. Few studies have combined publications count and citation analysis.

Although there are a number of informetric laws, the three most commonly used are Lotka's law of author productivity, Bradford's Law of Scattering, and Zipf's Law of word occurrence. Others include Booth's, Brooke's, Estroup's, Leimkuhler's, Pareto's, Price's, Willis', and others. Most of these laws apply to specific situations or patterns of scholarly communication and therefore, to date, there is no general bibliometric/informetric law. To this end, commendable attempts have been by various writers such as Price de Solla in developing a general bibliometric/informetric theory. Price's theory of Cumulative Advantage is considered to be the most popular explanation for bibliometric functions (Wallace, 1989). Although writers have criticized the formulation of equations related to the Cumulative Advantage theory, none have rejected it outright. O'Connor & Voos (1981:18) place blame on the approaches used to find a bibliometric theory, and advise that instead of dwelling on the similarities between various bibliometric models or laws, attention should be directed towards causal explanations of bibliographic phenomena. They argue that it is only then that informetrics can offer practical benefits to libraries.

The uses of informetrics are many and varied. The method can be used in pure/basic, and/or action/applied research. In Library and Information Science, informetrics is used in virtually all aspects of the discipline. For example in librarianship, informetrics is used to: estimate the comprehensiveness of secondary periodicals; identify the uses of different subjects; measure the usefulness of ad hoc and retrospective SDI services; identify core periodicals in different disciplines; formulate an accurate need-based acquisition policy within limited budgetary provision; adapt an accurate weeding and stacking policy; and index and abstract materials and collection development.

The next Chapter, Chapter three, offers a description of the methods, procedures and approaches used to conduct this study. It provides a description of the research design, research method, study area, target population, data collection instruments, tools of research, search strategies, and approaches and techniques used to analyze, present and interpret data.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This Chapter presents the methodological approaches and procedures used to conduct the current study. Methodology is defined as "*merely an operational framework within which the data are placed so that their meaning may be seen more clearly*" (Leedy 1997:102). Approaches to research methodology are classified according to two broad categories, namely, qualitative and quantitative research methodologies. The quantitative approach, sometimes referred to as the *traditional, positivist, experimental, or empiricist* approach, is "*typically used to answer questions about the relationships among measured variables with the purpose of explaining, predicting, and controlling phenomena*" (Leedy 1997:102). With the qualitative approach, sometimes called the *interpretive, naturalistic, constructivist,* or the *postpositivist* approach, Leedy (1997:102) observes that it is "*typically used to answer questions about the nature of phenomena with the purpose of describing and understanding the phenomena from the participants' point of view*". Boelaert (2001:4) differentiates the two approaches thus, "*the most obvious distinction (between quantitative and qualitative approaches) is that quantitative methods produce numerical data and qualitative methods result in information which can best be described in words*", and Neuman (2000:123) summarizes the differences between the two methodological approaches as follows:

Quantitative	Qualitative
- Test hypothesis that the researcher begins with	- Capture and discover meaning once the researcher becomes immersed in the data
- Concepts are in the form of distinct variables	- Concepts are in the form of themes, motifs, generalizations, and taxonomies
- Measures are systematically created before data collection and are standardized	- Measures are created in an ad hoc manner and are often specific to the individual setting or researcher
- Data are in the form of numbers from precise measurement	- Data are in the form of words and images from documents, observations, and transcripts
- Theory is largely causal and is deductive	- Theory can be causal or noncausal and is often inductive
- Procedures are standard, and replication is assumed	- Research procedures are particular, and replication is very rare
- Analysis proceeds by using statistics, tables, or charts and discussing how what they show relates to hypotheses	- Analysis proceeds by extracting themes or generalizations from evidence and organizing data to present a coherent, consistent picture

Table 3.1: Differences between quantitative and qualitative research (Source: Neuman, 2000:123)

Neuman (2000) and Leedy (1997) advise that both approaches to research design and method (i.e. quantitative and qualitative) may be used together to enhance research studies, but hasten to add that it is usually not necessary to combine the two. Nevertheless, the current study adopted the two approaches in determining the research design, data collection, analysis and presentation. The incorporation of the quantitative approach was partly dependent on the nature of the data to be collected, which was, to a large extent, numerical. An example of the qualitative approach may be found in the evaluation of sources through literature review.

This Chapter covers, among other aspects, the research design, research method, study area, target population, data collection instruments (i.e. content analysis and document study, use of existing statistics and databases), tools of research, search strategies, and data analysis and interpretative approaches.

3.2 Research design

- Research design, one of a number of research planning and presentation issues, is an important element in quantitative research because quantitative researchers' "*deductive approach emphasizes detailed planning prior to data collection and analysis*" (Neuman, 2000:122). In defining it, Saravanavel (1991:90) compares it to a blue-print produced by an architect before he/she begins construction; the strategy laid down by an army before an attack, or a design of an artist before the execution of his/her ideas. Simply put, research design is a plan for the collection and analysis of data. Saravanavel (1991:90) observes that research design should additionally be able to specify the sources and types of information relevant to the research question; the approach that will be used for gathering and analyzing data; and the time and budget available for execution.

Several preliminary tasks were performed before data collection regarding research design. These can be summarized as follows:

- The preparation of the research proposal. The research proposal was developed in consultation with the research supervisor and highlighted the following aspects of the study:
  - The Research topic, statement of the problem, aim and objectives, hypotheses, and data analysis and presentation.
- The preparation and presentation of the work plan (Appendix A), which, among other things, tentatively outlined the time of starting and completing the study, and gave a detailed timetable of the preparation and completion of the entire study.

3.3 Research method

Broadly speaking, the study employed content analysis to evaluate HIV/AIDS research in and about E&S Africa as published and reported in the MEDLINE, SCI and SSCI databases between 1980 and 2005. Content analysis is a research tool used to determine the presence of words or concepts in collections of textual documents. It is defined as a "*research technique for the objective, systematic, and quantitative description of manifest content of communications*" (Berelson in Palmquist, n.d.).

Palmquist (n.d.) observes that content analysis is used to "*determine the presence of certain words, concepts, themes, phrases, characters, or sentences within texts or sets of texts and to quantify this presence in an objective manner*". He defines texts as books, book chapters, essays, interviews, discussions, newspaper headlines and articles, historical documents, speeches, conversations, advertising, theater, informal conversation, or any other occurrence of communicative language. The uses of content analysis are varied. The method can be used to:

- Reveal international differences in communication content
- Detect the existence of propaganda
- Identify the intentions, focus or communication trends of an individual, group or institution
- Describe attitudinal and behavioral responses to communications
- Determine the psychological or emotional state of persons or groups

The current study applied informetrics to examine patterns of publication and the scientific impact of HIV/AIDS research in E&S Africa. The choice of this research method was founded on the basis that trends and developments in society, science and business can be traced through informetric analyses of databases (Wormell, 1998:25). Wormell (1998:25) further observed that such kinds of information are visible "*only to searchers who learn how 'to read between the lines' of the electronic information and can apply such modern information techniques as text mining*". Informetrics has been extensively used to study patterns of scholarly communication in various fields and the patterns of information production, organization, storage, retrieval, dissemination, and use. The theoretical foundation and development of informetrics is provided in Chapter 2.

Although heavily criticized for reasons already discussed in chapter 2 (Garfield, 1971; King, 1987; Garfield, 1989), publications count (a descriptive/quantitative method) and citations count and analysis (an evaluative/qualitative method) are the most used informetric indicators when evaluating research. On the one hand, publications count is the most widely favored variable in measuring research capacity by individuals, organizations and even countries (Ocholla, 2000). Citations count, on the other hand, is given preference when it comes to evaluating the journal or author's influence. Garfield (1971:179) argues that:

"Citation indexing can be used to facilitate evaluation of individual scientists or laboratories, but especially individual discoveries or inventions. 'Impact' factors are in many ways superior to publication counting, but each has its own special values. For example, publication counting can tell you little about the effect of a man's work on others. Citation indexing can".

The current study used the two informetric measurements – publications count and citation analysis – to study the patterns, types, and trends of literature production and the scientific impact of HIV/AIDS research in or about E&S Africa. Publications count was used to measure productivity using variables such as the number of publications by the authors' affiliate institution, publications per author, publication country, country researched on, category or subject area, collaboration, and year of publication, among other variables. Citation analysis was used to assess the number of citations, journal impact, author's impact, and other bibliometric indicators such as the number of sources cited and the types of sources cited. The application of these indicators in the analysis of data is presented in the Chapters four to seven.

3.4 Study area

Subject-wise, the focus of this study is HIV/AIDS research. In turn, the phrase "HIV/AIDS research" refers to all kinds of investigative studies that have been conducted and reported through publication in the subject area of HIV/AIDS (sometimes referred to as HIV and AIDS or simply AIDS), be it epidemiological-, prevention-, control-, drug therapy-, or treatment-based research activities regarding the disease and covered in MEDLINE, SCI and SSCI.

Fig. 3.1 shows the geographical scope of this study. Eastern Africa is the region that extends from Sudan in the North to Tanzania in the South, and comprises Djibouti, Eritrea, Ethiopia, Kenya, Somalia, the Sudan, Tanzania, and Uganda. Countries in the Southern African region include Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia, and Zimbabwe. Burundi and Rwanda were excluded from the E&S African region because they are commonly considered part of Central Africa. Other countries that were excluded were the islands (Wikipedia Encyclopedia, 2006). As mentioned in Chapter One, the choice of these regions lies in the fact that E&S African countries are the most affected in Sub-Saharan Africa by HIV/AIDS.

3.5 Target population

The study's population was drawn from publications on HIV/AIDS in or about E&S Africa as indexed and reflected in three key bibliographic databases, i.e. *MEDLINE, Science Citation index,* and the *Social Sciences Citation Index.* The target population may therefore be described as all those documents published on HIV/AIDS by or about E&S Africa between 1980 and 2005, [inclusive], as reflected in the three databases. The phrase 'by/in E&S Africa' refers to all documents authored and or published by authors residing in or citizens of E&S African countries, while the phrase 'about/on E&S Africa' refers to documents/records published by authors (both regional and international) about HIV/AIDS in E&S Africa. It therefore follows that papers published by the former may not necessarily deal with HIV/AIDS in E&S Africa. The papers may focus on HIV/AIDS research in any other geographic country/region. All the papers in the latter category (i.e. about/on E&S Africa), on the other hand, deal with HIV/AIDS research conducted about/on E&S Africa, i.e. E&S African countries are the subject of research. Included in the analysis were journal, newspaper and magazine articles, abstracts, notes and book reviews.

Fig. 3.1: E&S Africa (Source: http://www.worldatlas.com/webimage/countrys/africa/africaa.htm

3.6 Data collection instruments

Several documents were scanned for relevant data, which was then used to compile and support this thesis. Examples of these documents are conference papers, newspaper reports, journal articles, government reports, and related informetric studies.

Every attempt was made to get as many statistical reports related to HIV/AIDS as possible. Examples of these are demographic reports, the UNAIDS' yearly global HIV/AIDS updates, statistics on the international and national (local) funding of HIV/AIDS programs, national budgets of E&S African countries, etc.

Three bibliographic databases were earmarked for data collection. These sources included the following:

- **MEDLINE**, which is an electronic database created by the National Library of Medicine and offers a wide range of information on subjects such as medicine, nursing, dentistry, veterinary medicine, the health care system, and pre-clinical sciences from over 4600 medical journals. MEDLINE uses the Medical Subject Headings thesaurus, prepared by the National Library of Medicine, to index documents. The database includes citations from *Index Medicus, International Nursing Index, Index to Dental Literature, PREMEDLINE, AIDSLINE, BIOETHICSLINE,* and *HealthSTAR.*
- **Science Citation Index Expanded®** *Expanded* is a multidisciplinary index that caters for journal literature of the sciences. It fully indexes 5,900 major journals across 150 scientific disciplines—that's 2,100 more journals than the print and CD-ROM versions of the *SCI.* The *Science Citation Index Expanded* includes all cited references captured from indexed articles. In addition, the index provides access to current information and retrospective data from 1945 onwards and covers approximately 423,000 new cited references per week. Its subject coverage includes full-length, English-language-based texts in disciplines such as Agriculture, Astronomy, Biochemistry, Biology, Biotechnology, Chemistry, Computer Science, Materials Science, Mathematics and Medicine. Others are Neuroscience, Oncology, Pediatrics, Pharmacology, Physics, Plant science, Psychiatry, Surgery, Veterinary medicine and Zoology.
- **Social Sciences Citation Index®:** This too is a multidisciplinary index that covers the journal literature of the social sciences. It fully indexes more than 1,725 journals across 50 social sciences disciplines, and individually indexes selected relevant items from over 3,300 of the world's leading scientific and technical journals. Its strengths include the provision of access to current information and retrospective data from 1956 onward. Other strengths of the Index include an addition of [on average] 2,900 new records per week; the inclusion of approximately 60,000 new cited references per week; and the provision of searchable, full-length, English-language author abstracts for approximately 60% of the articles in the index. Its subject coverage includes Anthropology, History, Industrial relations, Library and information Science, Law, Linguistics, Philosophy, Psychology, and Psychiatry. Other disciplines

covered in the index include Political science, Public health, Social issues, Social work, Sociology, Substance abuse, Urban studies, and Women's studies.

3.7 Tools of research

Leedy (1997:18) defines the tool of research as "*what the researcher employs to amass data or manipulate them to extract meaning from them*". Just as every worker would require tools to effectively and efficiently conduct their businesses, so do researchers. Some of the tools used to achieve the desired goals include (Leeds, 1997:18):

- The library and its resources. Three libraries were extensively used in conducting this study, namely:
  - The University of Eastern Africa, Baraton Library
  - The Library at the University of Zululand
  - The University of KwaZulu Natal – Howard campus library

  In addition to these, the South African Bibliographic and Information Network (SABINET) acted as a tool for locating relevant resources, which were subsequently accessed electronically and through the Inter-library loan (ILL) services offered by SABINET. Resources that were obtained through the aforementioned libraries included electronic databases accessed through EBSCO (e.g. Academic Search Premier, Master File Premier, MEDLINE, etc), books, serials, statistical reports, etc.
- Computers and computer software. A laptop computer was heavily relied upon for word processing, data collection, analysis and presentation, and statistically manipulating the collected data using packages such as Microsoft® Word 2003 (©1983-2003) – Microsoft Corporation – and Microsoft® Excel 2003 (©1983-2003) – Microsoft Corporation. The study also applied Bibliometric toolkits (Bibexel), Sitkis, Citespace, TI, Pajek, UCINET and the Statistical Package for Social Sciences (SPSS) to check for relationships between citations and other variables. A desktop personal computer (PC) was also made available for the retrieval of relevant bibliographic data. The specific application of the bibliographic toolkits and software is provided under section 3.10.

- Statistics. Correlational tests were used accordingly to test for relationships between variables. Both descriptive and inferential statistics were applied in analyzing data.

3.8 Description and use of the bibliographic softwares

As mentioned in 3.7 above, the study used several computer programs to analyze data. This was necessitated by the fact that there were different aspects of the indicators that were the subject of the current study. The study's main focus areas were collaboration in HIV/AIDS research (co-authorship patterns), Sources of HIV/AIDS information (influence and productivity), HIV/AIDS researchers (influence and productivity) and topics and sub-topics of HIV/AIDS research (MESH terms). All these areas required different data analysis approaches which could not be adequately performed by a single software. The study of the topics and sub-topics of HIV/AIDS research thus required different software for analysis from, for example, an analysis of authors' influence (impact) or journal use. Secondly, some file formats required different computer software for analysis. For example, although Bibexcel.exe can be used for citation analysis, it was Sitkis.exe which was used to analyze the frequencies of occurrence of units of analysis in the case of ISI's records (file inputs) due to the software's compatibility. Likewise, Sitkis.exe and citespace.jar could not be used to analyze input files generated from MEDLINE because they are more applicable when analyzing records generated from citation indexes. Thirdly, the choice of the software used to conduct a particular analysis depended on the researcher's knowledge of the software's applicability. The following is a brief description of each program as well as an explanation of how each program was applied in data analysis[1].

3.8.1 TI

TI is freely available software for academic application. The program generates a word-occurrence matrix, a co-occurrence matrix, and a normalized co-occurrence matrix from a set of text files and a word list. The output files can be read into standard software (like SPSS, Ucinet/Pajek, etc.) for statistical analysis and visualization. There are two input files, namely, (a) the name of the file <words.txt> that contains the words (as variables) to be analyzed in ASCII format and (b) the

[1] Please note that much of the descriptive content for each of the programs is as provided by the developers. Only a few sections have been modified by the researcher.

number of files <text.txt> that contain the text elements as cases. The program's output files include the following:

a. *matrix.dbf* contains an occurrence matrix of the words in the texts. This matrix is asymmetrical: it contains the words as the variables and the texts as the cases. Each row represents a text in the sequential order of the text numbering, and each column represents a word in the sequential order of the word list. It is advisable to sort the word list alphabetically before analysis. The words are also the variable names, although truncated to ten positions. The words are counted as frequencies. (The plural "s" is removed before processing). This file can be imported into SPSS or Microsoft Office Excel for further analysis.

b. *coocc.dbf* contains a co-occurrence matrix of the words from this same data. This matrix is symmetrical and contains the words both as variables and as labels in the first field. The main diagonal is set to zero. The number of co-occurrences is equal to the multiplication of occurrences in each of the texts. The procedure is similar to using the file matrix.dbf as input to the routine "affiliations" in Ucinet, but the main diagonal is set to zero in this matrix. The file *coocc.dat* contains this information in DL-format.

c. *cosine.dbf* contains a normalized co-occurrence matrix of the words from the same data. Normalization is based on the cosine between the variables conceptualized as vectors (Salton & McGill as cited by Leysderdorff, 2004). The procedure is similar to using the file matrix.dbf as input to the corresponding routing in SPSS. The file *cosine.dat* contains this information in DL-format.

This program was used to conduct a co-word analysis on HIV/AIDS literature as explained in Chapter Seven.

The program is also freely available for academic use and can be downloaded from http://users.fmg.uva.nl/lleydesdorff/software/ti/index.htm

3.8.2 Bibexcel

Bibexcel is designed as a tool box for manipulating bibliographic data. The results of all manipulations are saved in files that can be opened with Excel or any other software reading text-files tabbed into columns. Bibexcel allows one to combine information from several fields of a document record, count frequencies, co-occurrences and shared units (bibliographic coupling). There is also a procedure for finding citation links among the documents within a given set. Above all, the tools can be combined - the result of using them depends far more on one's own imagination than the tools themselves. The program is also capable of providing the following results:

- most productive authors
- most productive journals
- most cited documents
- most cited authors

This study used Bibexcel to analyze data collected from the MEDLINE database in order to obtain the frequencies of occurrence of several units of analysis, such as authors, journals, language of publication, main MESH subject headings, sub-fields of HIV/AIDS research, year of publication, and author institutional affiliation, etc.

The program is freely available from www.umu.se/inforsk/Bibexcel/

3.8.3 Sitkis

Sitkis is citation data processing software. It is Java software for most versions of Windows. The software imports ISI Web of Science files into a Microsoft Access database that can be easily modified. Sitkis also exports data from the database into UCINET compatible network graphs and Excel-compatible reports. The purpose of the program is to enable researchers to easily and quickly download and analyze bibliometric records. The software is capable of performing the following tasks:

- 2-mode factor analysis
- Calculation of article similarity based on common preferences
- Calculation of co-citation networks from article-to-reference data
- Calculation and preparation of author co-authorship networks and frequencies
- Calculation of institutional contributions and collaboration networks
- Cross-border research collaboration
- Calculation of article cross-citations

- Generation of the following types of statistics:
  - Reference statistics
  - Yearly citation statistics
  - Article statistics
  - Article / reference centrality statistics

The statistics generated from the aforementioned analyses can be exported to Excel-friendly tab-delimited files. The program was used in this study to prepare a database which was in turn used to obtain the frequencies of occurrences of the units of evaluation. The generated database was in Microsoft Office Access format. It provided the following information:

- Tables (e.g. authors' addresses, cited articles, citing articles, institutes, citing authors, discarded citations, and keywords)
- Queries (e.g. articles per year of publication, author and article citations, journal citations, co-authorship between two or more authors, productivity by country, journal and author, and institutional collaboration).

The program may be freely downloaded from http://www.sitkis.org or http://users.tkk.fi/~hschildt/sitkis/ for academic use.

3.8.4 Citespace

CiteSpace visualizes the evolution of a network across a number of time sliced intervals. It is a java program for co-citation analysis, specifically for visualizing co-citation networks. Currently, it takes citation data in ISI Export format and generates node-and-link drawings of co-citation networks. A typical way of using it involves slicing a time interval into smaller segments in order to study how co-citation networks over individual time slices are patched together. The program uses the following information of a bibliographic record to generate maps: (a) authors (b) title, descriptors, identifiers, and abstract (c), cited references (d) times cited and (e) year of publication. The co-citation networks that the program generates include:

- Author co-authorship networks created by analyzing the citing authors
- Author co-citation networks created by analyzing the cited authors
- Document co-citation networks made by analyzing the cited documents

- Journal co-citation networks created by analyzing the cited journals
- Co-term networks created by analyzing the identifiers, abstracts and descriptors

This study used the program to prepare the author co-authorship networks that are provided in Chapter four – HIV/AIDS collaboration in E&S Africa. Once the networks were generated, they were exported to Pajek for visualization.

The program is freely available from http://cluster.cis.drexel.edu/~cchen/citespace for academic use.

3.8.5 Pajek

Pajek is a program used to analyze large networks, and is arguably the best drawing program on the market. Developed by Vladimir Batagelj (Department of Mathematics, University of Ljubljana, Slovenia) and Andrej Mrvar (Faculty of Social Sciences, University of Ljubljana, Slovenia), the program is Windows-based and is capable of analysing and visualizing large networks containing thousands or even millions of vertices. It is freeware software (used for academic purposes), and can be downloaded from http://vlado.fmf.uni-lj.si/pub/networks/pajek/. The file format accepted by Pajek provides information on *vertices*, *arcs* (directed edges), and undirected *edges*. The program was used to prepare networks provided in Chapters Four and Seven.

3.9 Search strategy

Two sets of terms/keywords used in searching for and downloading relevant bibliographic data from the three databases were constructed. Table 3.2 consists of the names of countries and regions in E&S Africa, while Table 3.3 comprises HIV/AIDS and related search terms. Each set's descriptors, are as shown below.

Table 3.2: List of countries and regions used in downloading papers from MEDLINE, SCI and SSCI

Angola	Botswana	Djibouti	Eritrea	Ethiopia
Kenya	Lesotho	Malawi	Mozambique	Namibia
Somalia	South Africa	Sudan	Swaziland	Tanzania
Uganda	Zambia	Zimbabwe	Eastern Africa	Africa, Eastern
Africa, Southern	Southern Africa			

Table 3.3: List of terms used to identify HIV/AIDS papers from MEDLINE, SCI and SSCI

Acquired Immunodeficiency Syndrome	Immunodeficiency syndrome, Acquired	Immunologic Deficiency Syndrome, Acquired	Acquired Immune Deficiency Syndrome	Pneumonia, Pneumocystis Carinii
AIDS Arteritis, Central Nervous System	AIDS Dementia Complex	AIDS Seropositivity	HIV Seroprevalence	Immunologic Deficiency Syndromes
HIV*	HTLV-III	LAV-HTLV-III	Receptors, HIV	mmunoblastic Lymphadenopathy
Human T-Cell Lymphotropic Virus Type III	Sarcoma, Kaposi's	Human Immunodeficiency Virus	AIDS related complex	Human T Lymphotropic Virus Type III
Cytomegalic Inclusion Disease	Immunodeficiency Virus, Human	Virus, Human Immunodeficiency	Viruses, Human Immunodeficiency	Reverse Transcriptase Inhibitors
Human T-Cell Leukemia Virus				

A combination of each of the keywords in Table 3.3 with the geographic names in Table 3.2, using an advanced mode of searching, was adopted in extracting HIV/AIDS documents from MEDLINE, SCI and SSCI. It should, however, be noted, that because the three databases do not share search platforms, two separate strategies were employed to search for HIV/AIDS records. The MEDLINE database's search platform differs from that of the ISI's databases (i.e. ISI). Whereas data was extracted from SCI and SSCI using the same search platform, MEDLINE's data was downloaded separately.

In each case, the search was limited to the author's address, title, abstract, and subject fields. The databases allow users to combine search terms/keywords using Boolean operators (AND, OR, AND NOT, and SAME [in case of ISI]) when one uses the advance search mode. The following is an illustration of the format the search took. In the following example, TI is an abbreviation for Title, implying that the search was conducted within the Title Field.

TI Angola Or TI Botswana Or TI Djibouti Or TI Eritrea Or TI Ethiopia Or TI Kenya Or TI Lesotho Or TI Malawi Or TI Mozambique Or TI Namibia Or TI Somalia Or TI South Africa Or TI Sudan Or TI Swaziland Or TI Tanzania Or TI Uganda Or TI Zambia Or TI Zimbabwe, where TI is short form for Title.

Similar searches were conducted within the other fields using the fields' abbreviated forms as follows:

1. Subject – *SU* (in the case of MEDLINE) *or TS* (ISI)
2. Abstract – *AB* (only in MEDLINE)
3. Author's address – *AD* (ISI) *OR AF* (MEDLINE).

The following steps were employed in the collection of relevant data:

1. A search for the names of countries within the title, abstract and subject fields. This search yielded records specific to the countries that were the focus areas of the study.
2. A search for the names of countries within the author's address field. The search was meant to yield records authored by E&S African researchers.
3. A search for HIV/AIDS records using the search terms in Table 3.3 within the title, abstract and subject fields.
4. Search 1 (S1) and Search 2 (S2) were combined using the Boolean operator OR in the 'search history' platform in order to yield documents that were authored by E&S African authors and about E&S Africa.
5. In order to download HIV/AIDS publications authored by E&S African authors and about HIV/AIDS research in E&S African countries, Search 4 (S4) was combined with search 3 (S3).

All the searches were limited to 1980 to 2005, which was divided into eight three-year periods that excluded 2004-2005, i.e. 1980-1982, 1983-1985, 1986-1988, 1989-1991, 1992-1994, 1995-1997, 1988-2000, 2001-2003, and 2004-2005. A total of 6476 (MEDLINE) and 6557 (ISI) records were retrieved, and upon screening the data, 6178 and 6367 records were analyzed.

Table 3.4: Distribution of publications by country, 1980-2005

	1980-1982		1983-1985		1986-1988		1989-1991		1992-1994		1995-1997		1998-2000		2001-2003		2004-2005		TOTAL	
	M	ISI	M	ISI	M	ISI	M	ISI	M	ISI	M	ISI	M	ISI	M	ISI	M	ISI	M	ISI
Angola	0	0	0	0	4	2	2	1	2	0	2	2	0	2	1	1	4	2	15	10
Botswana	0	0	0	0	0	0	2	1	6	3	12	2	22	23	46	58	32	46	120	133
Djibouti	0	0	0	0	0	0	4	6	7	6	1	4	1	5	2	2	2	2	17	25
Eritrea	0	0	0	0	0	0	0	0	0	0	0	0	4	4	1	0	1	0	6	4
Ethiopia	2	0	0	0	4	3	21	14	37	31	45	37	45	59	79	95	36	42	269	281
Kenya	1	0	5	1	22	17	64	65	67	114	118	166	113	213	167	231	106	169	663	976
Lesotho	0	0	0	0	0	0	0	0	0	0	6	2	2	4	4	7	5	4	17	17
Malawi	1	0	0	0	2	1	14	12	35	28	60	72	57	106	86	163	86	123	341	505
Mozambique	0	0	0	0	3	0	4	2	5	6	13	9	4	10	17	16	10	13	56	56
Namibia	0	0	0	0	1	1	2	1	2	3	9	5	8	8	5	7	3	3	30	28
Somalia	0	0	0	0	3	1	7	3	2	3	0	2	2	2	0	1	1	1	15	13
South Africa	0	0	6	10	32	24	108	70	140	128	225	210	546	506	730	779	418	586	2205	2313
Sudan	1	0	1	0	5	1	4	4	4	2	7	7	3	13	6	18	2	7	33	52
Swaziland	0	0	0	0	0	0	2	1	2	4	1	2	10	4	3	10	5	14	23	35
Tanzania	1	0	3	0	18	8	51	32	85	80	129	139	102	183	102	231	69	152	560	825
Uganda	3	0	10	0	29	7	80	47	115	124	171	144	193	232	196	316	152	254	949	1124
Zambia	0	0	5	0	21	9	42	30	72	74	96	98	52	101	72	141	59	81	419	534
Zimbabwe	0	0	1	0	8	4	59	23	78	61	103	69	94	94	86	145	50	106	479	502

Table 3.4 shows the distribution of these records according to the country of research by year of publication. The Table provides the total number of records for each country, without duplicates which were removed at the data analysis stage. However, those records which discussed HIV/AIDS research in two countries or were co-authored by two or more researchers were separately counted in each country of author affiliation. A detailed description of the approaches used to analyze and present data is provided under the individual Chapters four to seven.

3.10 Problems Encountered

A number of problems, both internal (limitations associated with the researcher) and external (limitations beyond the researcher's control) were encountered before, during and after the study. At the very beginning, it was very difficult to get relevant information resources, which were then required to compile the research proposal. The study program neccesitated that a research proposal be prepared, outlining the research problem, and purpose and objectives of the study, among other requirements. Information resources that could have assisted in preparing the research proposal were not immediately available. The researcher had to write to and request materials from the respective authors, whose assistance has been acknowledged in the preliminary pages.

Further problems were encountered during the study. These included problems associated with data collection. First, the ISI databases, particularly the back issues of SCI and SSCI, were not immediately available at the University of Zululand, a fact that delayed the collection of data. However, this problem was solved by the availability of the ISI databases at the University of KwaZulu Natal (Howard Campus Library) where the data collection exercise was conducted.

The second problem that was encountered during the course of this study was in relation to time. The researcher was fully employed, a condition that put a lot of pressure at his place of work due to the heavy workload. The situation did not permit the researcher to have enough time to exhaustively conduct the study. However, every effort was made to ensure that time was created so that the most important aspects of the research were incorporated into the study. Much of the study was conducted in the evenings, i.e. after work, and the researcher additionally traveled to the University of Zululand during his annual leaves in order to make up for lost time.

3.11 Summary

This chapter dealt with the research approaches employed to conduct the study on the patterns of production and distribution of HIV/AIDS literature in and about E&S Africa, aiming to assess the trends and patterns of research in HIV/AIDS in the two regions between 1980 and 2005.

Both quantitative and qualitative approaches were used when designing and planning this study. The study made use of three informetric approaches, i.e. publications count, citations analysis and co-word analysis, to fulfill its general objectives. These approaches were combined in order to supplement each other's inadequacies.

This chapter also outlines the approaches that were used to analyze, present and interpret the data, as well as the problems that were encountered before, during and after data collection. Specific data analysis, presentation and interpretation approaches are provided in Chapters four to seven.

The next Chapter deals with HIV/AIDS research collaboration. The Chapter aims to provide insights into the nature, trends and types of collaboration in HIV/AIDS research in E&S Africa. It focuses on the extent and degree of collaboration; collaborating countries, institutions and individuals; and the effect of collaboration on the scientific impact of HIV/AIDS research.

CHAPTER FOUR

COLLABORATION IN HIV/AIDS RESEARCH

4.1 Introduction

According to Kostoff (2001) and Katz & Martin (1997), collaboration amongst researchers has been increasing steadily for decades, covering different disciplines, development categories, institutions, geographical regions, and countries, with the belief that *"collaboration in research is 'a good thing' and that it should be encouraged"* (Katz & Martin, 1997:1). Consequently, interest in research collaboration has increased within policy circles. This rapid evolvement of collaboration may be attributed to the *"increasing specialization across disciplines and fields, the complexity of research problems, the rising costs of technological apparatus, the development of new information and communication technologies, and lower travel costs"* (Duque, Ynalvez, Sooryamoorthy, Mbatia, Dzorgbo & Shrum, undated). Therefore, it has been associated with the scope of the problem combined with complexity and cost, which suggest or even dictate broad collaboration that increasingly involves international partners. Smith & Katz (2000: concepts of collaboration) attribute the recent vigorous promotional campaigns for collaboration to the following specific factors:

- The growth of the knowledge economy and attempts to strengthen the economic and social contributions of research;
- A shift towards more applied research in collaboration with other knowledge creators and users;
- Greater concentration of research activity and partnership in the use of the plant, equipment and expertise;
- The growth of a directed mode of funding based on priority areas and problem oriented project funding; and
- A shift towards a mass higher education system and lifelong learning.

Rao & Raghavan (2003:230) observe that collaboration in research has become an *"inevitable and essential research component of every field"*. The realization that through collaboration, research can be conducted effectively with minimum costs, in addition to other benefits, has resulted in the launch of numerous initiatives aimed at encouraging and strengthening collaboration among individual researchers as well as institutions, particularly between university and industry researchers (Katz & Hicks 1997). Katz & Martin (1997:1) note that:

> *"There have also been policies aimed at improving the links between science and technology through fostering research collaboration across sectors – in particular, between university and industry. Furthermore; most governments have been keen to increase the level of international collaboration engaged in by the researchers whom they support in the belief that this will bring about cost-saving or other benefits".*

Researchers have observed that African countries enjoy strong collaborative links with the rest of the world in biomedical and/or health research, particularly in areas such as malaria (Beattie, Renshaw, & Davis, 1999). In their bibliometric study of science in Africa, Narvaez-Berthelemont, Russell, Arvanitis, and Gaillard (2001:472), noted that 80% of the studied countries (i.e. 12 out of 15) "*published more than 50% of their publications in international collaboration*". Institutional collaboration indicated that African institutions largely collaborated with institutions in the United States, followed by those in France and the United Kingdom. Fields that involve heavy research collaboration, according to the authors' findings, include Biomedical Research, Biology, Earth and Space Science, and Physics. With regard to HIV/AIDS, Macias-Chapula & Mijangos-Nolasco (2002) noted a high pattern of collaboration involving two or more authors (i.e. 91.54%) in a bibliometric analysis of AIDS literature in Central Africa. Although Cohen (2000c) provides a list of both the institutions and countries collaborating with African countries in HIV/AIDS research, and the subject areas of research collaboration, the type, extent, trends and degree of this collaboration have, however, not been identified or explored.

Broadly, the purpose of this Chapter was to examine the trend and type of HIV/AIDS research collaboration in E&S Africa in order to recommend ways of improving and/or strengthening such collaborative activities. With this objective in mind, the chapter focuses on the following research sub-questions:

- What is the trend of single and multiple-author papers between 1980 and 2005?

- What is the degree and extent of HIV/AIDS research collaboration in E&S Africa?
- What are the types of collaboration in HIV/AIDS research, i.e. domestic, regional and international, etc?
- Who or which are the collaborating authors, institutions, and countries in the two regions?
- What is the growth rate and composition of author collaborative networks in E&S Africa?
- Which geographic areas are the research focus of the major author networks?

In order to examine these questions, this Chapter is divided into the following sections: an overview of research collaboration; collaboration in HIV/AIDS research in E&S Africa; specific methods and procedures that were followed in presenting and interpreting data on research collaboration; presentation of the findings; discussions of the findings; and a summary of the Chapter.

4.2 Research collaboration: an overview

The terms research and collaboration seem to be well understood, which is in contrast to the phrase "research collaboration". Collaboration has been defined as the process during which two or more individuals or organizations deal collectively with issues that they cannot solve individually (Ecosystem Management Initiative, 2002). It is generally acknowledged that research collaboration "*has a very fuzzy or ill-defined border*" and "*perceptions regarding the precise location of the 'boundary' of the collaboration may vary considerably across institutions, fields, sectors and countries as well as over time*" (Katz & Martin, 1997:8). That notwithstanding, a variety of definitions have been provided to explain what research collaboration entails. According to the Commonwealth of Australia (2004:1), collaboration is a "*partnership, alliance or network, aimed at a mutually beneficial clearly defined outcome*". Diodato (1994:47) defines collaboration as a "*concept of two or more researchers (or researchers from two or more organizations or countries) working together*" (Diodato, 1994:47), while Laudel (2001:370) views research collaboration as a "*system of research activities by several actors related in a functional way to attain a research goal corresponding with these actors' research goals or interests*".

Katz & Martin (1997, who are the research collaborators? section) suggest the following criteria for identifying research 'collaborators'. They suggest that collaborators may include those who: work together on a research project throughout its duration or for a large part of it, or who make frequent or substantial contributions; those whose names or posts appear in the original research proposal; those responsible for one or more of the main elements of research (e.g., the experimental design, construction of research equipment, execution of the experiment, analysis and interpretation of the data, or writing up the results in a paper); those responsible for a key step (e.g., the original idea or hypothesis, the theoretical interpretation); or the original project proposer and/or fund raiser, even if his or her main contribution is subsequently constrained to the management of the research (e.g. as team leader), as opposed to research *per se*. The authors opine that a group of collaborators will generally exclude those who make only an occasional or relatively minor contribution to an aspect of research; and those not seen or treated as 'proper' researchers (e.g. technicians, research assistants).

There are several unique benefits that accrue from research collaboration. Katz & Martin (1997, what are the benefits and costs of collaboration? section) observe that collaboration: enables researchers to share knowledge, skills and techniques; is one way of transferring knowledge (especially tacit knowledge); may bring about a clash of views, a cross-fertilization of ideas which may in turn generate new insights or perspectives that individuals, working on their own, would not have grasped; provides intellectual companionship; plugs the researcher into a wider network of contacts in the scientific community; and enhances the potential visibility of the work.

It should, however, be borne in mind that collaboration has its costs. In the first instance, it may bring about additional funding costs in the form of travel and subsistence. Other costs may involve time and administration (Katz & Martin, 1997, what are the benefits and costs of collaboration? section). Collaboration may also be hindered by geographical, cultural, disciplinary and political barriers.

In informetric assessments, research collaboration is measured on the basis of co-authorships. Co-authorship, also referred to as multiple-authorship or joint authorship, refers to "*an instance in which two or more individuals jointly author*" (Diodato, 1994:6). Collaboration is often synonymously used with multiple-authorship and/or co-authorship although, as Diodato (1994) notes, some writers prefer the use of co-authorship for documents authored by exactly two authors. Although well acknowledged as a key indicator of collaboration, the co-authorship approach to assessing research collaboration has its pitfalls, the first of which is that the practice rests on several challengeable assumptions, namely:

- That all people who appear as a paper's co-authors actually took part in the research collaboration; and
- That all scientists who collaborate become co-authors (Laudel 2001:369).

The National Science Foundation [NSF] (1996) notes that the use of co-authorship to analyze patterns of collaboration has unwelcome consequences. For instance, the Foundation notes that:

> *"A paper written by a U.S. citizen temporarily residing in the United Kingdom in collaboration with someone at his U.S. home institution is counted as internationally coauthored, thus overstating (in one sense) the extent of such collaboration. On the other hand, a paper coauthored by a British citizen located in the United States and collaborating with someone at the host institution would not be considered internationally coauthored, thus understating the count. Further, the data presented here do not permit the examination of collaboration involving three or more countries."*

That notwithstanding, co-authorship as a measure of research collaboration has been extensively used and generally accepted in informetric research as outlined in section 5.5. As Glazel (2002: Introduction, para. 1) notes "*collaboration in research is reflected by the corresponding co-authorship of published results, and can thus be analyzed with the help of bibliometric methods*". Gauthier (1998) also argues that co-authorship remains the most commonly used bibliometric/informetric indicator in describing collaboration and co-operation.

According to Katz & Martin (1997), one of the paradoxes of measuring research collaboration is making a conceptual distinction between different types of collaboration. Seemingly, the type of collaboration is defined by the level at which collaboration takes place. Smith & Katz (2000) classifies these levels into six categories, namely, individuals, groups, departments, institutions, sectors and countries, hence Katz & Martin's (1997) identification of three types of collaboration, i.e. inter-individual, inter-institutional, and inter-national. In addition to these three types of collaboration, Smith & Katz (2000) label collaboration between different sectors as inter-sectoral collaboration. Macias-Chapula & Mijangos-Nolasco (2002) also mention three such collaborations, i.e. inter-institutional, inter-national and North-South types of collaboration. Aside from what Laudel (2001) calls "*collaborative types constructed by the criteria of the contributors' institutional affiliation (intra-research group, intradepartmental, and international)*", the author classifies the types of collaboration into collaboration involving a division of labor, service collaboration, provision of access to research equipment, transmission of know-how, mutual stimulation and trusted assessorship. Kreiner & Schultz (1993) and Smith & Katz (2000) categorize collaboration into informal and formal collaboration, the former being the most common in research cycles.

4.3 The status of collaboration in HIV/AIDS research in E&S Africa

In the words of De Cock, Gnamore, Kadio & Gayle (1994), HIV/AIDS research has resulted in an increased collaboration between key researchers and research groups. Indeed, since the diagnosis of the pandemic in the early 1980s, the region has witnessed a tremendous growth in research networks involving mostly foreign and domestic researchers. HIV/AIDS research has brought on board a variety of researchers from different disciplines, perhaps due to its developmental impact on the social, economic and political sectors. Cohen (2000c) provides a detailed description of HIV/AIDS research collaborations whose summary is illustrated in Table 4.1. The following is a review of Cohen's (2000c) study on HIV/AIDS research collaboration specific to E&S Africa.

In Kenya, Cohen observes that what began as a humble friendship when Canadian scientists requested Kenyan researchers at the University of Nairobi for assistance on research in genital ulcers, then blossomed into one of the longest running and most productive AIDS research collaborations in Africa. Many more foreign researchers have since joined these collaborative efforts. Based mainly in Nairobi and Mombasa, the two largest cities in Kenya, AIDS research in the country has attracted researchers from the University of Manitoba (Canada), University of Washington (USA), University of Ghent (Belgium), Oxford University (UK) and the Institute of Tropical Medicine, Antwerp (Belgium). The local participating researchers are from the University of Nairobi and the Ministry of Health. These researchers' focus areas include sexually transmitted diseases (STDs), mother-to-child-transmission (MTCT), sex workers, vaccines, immunology, epidemiology, highly exposed persistently seronegative people (HEPS), microbicides, and transmission, as shown in Table 4.1.

In the case of Botswana, where 37.3% of the country's population was HIV positive as at 2004 (UNAIDS, 2006), Cohen observes that the main foreign HIV/AIDS research collaborators are from Harvard University (UK) and the McGill University (Canada). The local participants are mainly from the Ministry of Health. The research, which focuses on sub-fields such as antiretroviral resistance, MTCT, vaccine design, viral subtypes, and the National Institutes of Health's (NIH) vaccine trials network (VTN), is mainly based in the city of Gaborone and various villages.

AIDS research in Ethiopia, according to Cohen, is in the form of a project named the Ethio-Netherlands AIDS Research Project (ENARP), which brings together researchers from the University of Amsterdam (Netherlands) and the Netherlands Red Cross (Netherlands). An annual budget of US$ 2 million has been allocated to the project since 1994, courtesy of the Netherlands Ministry for Development and Cooperation, towards research in natural history, epidemiology, and viral subtypes. The research collaborative activities are centered in Addis Ababa, the capital city of Ethiopia.

Malawi's main AIDS research partner, says Cohen, is the USA. Foreign research collaborators stem from Johns Hopkins University and the University of North Carolina, while their local counterparts are from the Malawi College of Medicine and Lilongwe Central hospital. Based in Blantyre and Lilongwe, the key areas of research include the NIH's HIV Network for Prevention Trials (HIVNET), MTCT, vitamin A, human herpesvirus-8, Kaposi's sarcoma (KS), and microbicides. Annually, the NIH spends approximately US$1.4 million on AIDS research in Malawi.

In Tanzania's case, foreign collaborating researchers are drawn from the Swedish Institute for Infectious Disease Control (Sweden), the University of Umea (Sweden), University of Munich (Germany), and Harvard University (UK), while local/domestic researchers stem from Muhimbili University and the Ministry of Health. Research collaboration is primarily focused on epidemiology, immunology, natural history, behavior, MTCT, TB, vaccines, superinfection, subtypes and vitamins. Again, research is based in the country's major cities (i.e. Dar es Salaam, Kagera, and Mbeya).

Country	Collaborating foreign country	Collaborating foreign inst.	Collaborating local inst.	Sub-field(s) of HIV/AIDS research collaboration
Burundi	-	-	-	-
Djibouti	-	-	-	-
Eritrea	-	-	-	-
Ethiopia	Netherlands	University of Amsterdam, Netherlands Red Cross	ENARP: Ethio-Netherlands AIDS Research project	Natural history, epidemiology, viral subtypes
Kenya	Canada, USA, Belgium, UK	Univ. of Manitoba, Univ. of Washington, Univ. of Ghent, Oxford Univ. ITM	University of Nairobi, Ministry of Health	STDs, MTCT, Sex workers, vaccines, immunology, epidemiology, HEPS, microbicides, transmission
Rwanda	USA	Univ. of Alabama, Johns Hopkins	National Reference Lab	Long term survivors, Vitamin A
Somalia	-	-	-	-
Sudan	-	-	-	-
Tanzania	Sweden, Germany, UK	Swedish Institute for Infectious Disease control, University of Umeå, Univ. of Munich, Harvard Univ.,	Muhimbili Univ., Ministry of Health	Epidemiology, immunology, natural history, behavior, MTCT, TB, vaccines, superinfection, subtypes, vitamins
Uganda	USA, UK, Belgium, Italy	Johns Hopkins Univ., Imperial College London, ITM, Case Western Reserve Univ., UK MRC, University of Milan, Columbia Univ., US NIAID	Makerere Univ., Mulago Hospital, Uganda Virus Research Institute, Lacor Hospital,	MTCT, STDs, Education, HIVNET, Vitamin A, vaccines, pathogenesis, TB, Natural history, immunology
Angola	-	-	-	-
Botswana	UK, Canada	Harvard University, McGill University	Ministry of Health	Antiretroviral resistance, MTCT, Vaccine design, viral subtypes, VTN
Lesotho	-	-	-	-
Malawi	USA	Johns Hopkins Univ., Univ. of North Carolina	Malawi College of Medicine, Lilongwe Central Hospital	HIVNET, MTCT, Vitamin A, human herpesvirus-8, KS, MTCT, microbicides
Mozambique	-	-	-	-
Namibia	-	-	-	-
South Africa	USA	HIVNET, Columbia Univ., Population Council	Medical Research Council, Univ. of Natal, Univ. of Durban, Univ. of Cape Town, Univ. of Stellenbosch, Chris Hanni Baragwanath Hospital	Vaccines, STDs, Migrants, Sex workers, epidemiology, VTN, Virology, TB, MTCT, Microbicides, immunity, pediatrics,
Swaziland	-	-	-	-
Zambia	USA, Belgium, UK	Univ. of Alabama, ITM, London School of Hygiene and Medicine	Zambia UABHIV Research Project, Univ. teaching Hospital, Ministry of Health, Tropical Disease Research Center	Discordant couples, TB, Transmission, natural history, acute infection
Zimbabwe	USA	UC San Francisco, Stanford Univ.	University of Zimbabwe	HIVNET, STDs, microbicides, MTCT, immunology

Table 4.1: Collaborating countries and institutions in HIV/AIDS research in E&S Africa (Source: Cohen, 2000b:2156)

Key: HIVNET: NIH's HIV Network for Prevention Trials; ITM: Institute of Tropical Medicine, Antwerp; KS: Kaposi's sarcoma; MTCT: mother-to-child transmission; STDs: sexually transmitted diseases; TB: Tuberculosis; VTN: NIH's Vaccine Trials Network

South Africa's AIDS research network is the most developed, especially within its institutions. Spread throughout the country, AIDS research is conducted in the country's major cities, which include Hlabisa, Mtubatuba, Durban, Cape Town, Soweto, and Pietmaritzburg. The local centers of AIDS research are the Medical Research Council, University of Natal (currently, the University of KwaZulu Natal), University of Durban-Westville (now, the University of KwaZulu Natal), University of Cape Town, University of Stellenbosch, and Chris Hanni Baragwanath Hospital. Although much of the funding emanates from external sources such as the International AIDS Vaccine Initiative (IAVI), Wellcome Trust, NIH, and the Population Council, collaboration among South African organizations, particularly between and within the local universities, is very strong. For instance, Cohen notes strong collaborative links between the universities of Natal and Durban (these two universities have since merged to be called University of KwaZulu Natal) and the universities of Cape Town and Stellenbosch. Foreign research participants include HIVNET, the Population Council, and Columbia University. Collaborative activities are focused on sub-fields of AIDS research such as vaccines, STDs, migrants, sex workers, epidemiology, VTN, virology, Tuberculosis (TB), MTCT, microbicides, prevention, pediatrics, HIVNET, and immunity.

Uganda, a country that has recorded success in the fight against AIDS, collaborates mainly with the UK and USA. The country's participating institutions include Makerere University, Mulago Hospital, Uganda Virus Research Institute and Lacor hospital, while those from foreign countries include Johns Hopkins University, Case Western Reserve University, Imperial College London, ITM, UK Medical Research Council, University of Milan (Italy), Columbia University, and the National Institute of Allergy and Infectious Diseases – NIAID (USA). With an annual budget of approximately US$15 million – most of which is externally funded – research is centered on MTCT, STDs, education, HIVNET, vitamin A, vaccines, pathogenesis, TB, natural history, immunology, subtypes, and epidemiology.

In Zambia, researchers in the Zambia UAB HIV research project, the University Teaching Hospital, the Tropical Disease Research Center, and the Ministry of Health collaborate with their counterparts from the University of Alabama, ITM, and the

London School of Hygiene and Tropical Medicine. Jointly, these researchers conduct research in and about discordant couples, TB, transmission, natural history, and acute infection.

Finally in Harare, Zimbabwe, AIDS research collaboration involves the University of Zimbabwe (regionally) and the University of California and Stanford University (internationally). Their main areas of research include HIVNET, STDs, microbicides, MTCT and immunology.

Despite these success stories on research collaboration in HIV/AIDS research in Africa between researchers based in Africa and those from developed countries such as the U.S., Canada, and Sweden, all has not been well. Stresses and strains have characterized most projects undertaken by researchers in Africa in conjunction with their foreign colleagues. Cohen (2000a) observes that tensions have been high regarding equity (i.e. access to financial resources and facilities, participation, transfer of technology, self reliance, training opportunities, and credit) and the African researchers' use of lab facilities to conduct personal businesses. A question that has also generated heated international debate is what ethics are appropriate for research in different countries and geographical regions, especially when conducting HIV trials on humans. In the words of Silverio (2002: introduction, para 1), "*questions have arisen regarding how American researchers conduct studies in Africa. This controversy stems from the fact that HIV research on human subjects affects the economic and social welfare of the population under study*".

The result of these collaborative initiatives in AIDS research on E&S Africa has been the publication of high-profile AIDS papers. Sadly, though, informetric studies on the considerable literature produced in and about E&S Africa are rare. Thus far, no study has been conducted to specifically analyze the patterns, trends and types of collaboration in AIDS research in the region. Nevertheless, several informetric studies have been conducted to broadly analyze the patterns and trends of AIDS research, particularly in both developed and developing countries (e.g. Macias-Chapula, 2000; Macias-Chapula & Mijangos-Nolasco, 2002; Onyancha & Ocholla, 2004b; Macias-Chapula, Mendoza-Guerrero, Rodea-Castro, Gutierrez-Carrasco & Juarez-Sanchez, 2006; Onyancha & Ocholla, 2006). Some of these studies have identified patterns of collaboration in AIDS research through the use of co-authorship.

In a bibliometric study conducted by Macias-Chapula (2000:57) intent on "*providing an insight into the construction and administration of AIDS knowledge*" in Haiti, 75% of the total 363 Haitian HIV/AIDS records were published in collaboration between two or more authors. Using co-authorship to determine the pattern of collaboration, Macias-Chapula & Mijangos-Nolasco (2002) also noted a high pattern of collaboration through multiple-authorship (i.e. 91.54% of the publications were co-authored) in a study on AIDS literature in Central Africa.

Studies have also shown that the key players in HIV/AIDS research collaboration in South Africa are the local universities in the country (Dube & Ocholla, 2004). In a study conducted to review the management and diffusion strategies of HIV/AIDS information in South Africa, Dube & Ocholla (2004) noted a high pattern of research collaboration (73%) among local academic institutions. The authors observed that 33% of the local institutions of higher learning "*collaborate with international institutions, and about 78% with provincial and national government departments in conducting research on HIV/AIDS and related areas*" (Dube & Ocholla, 2004:167).

Generally, the reviewed studies (except for Dube & Ocholla [2004] which partially identifies domestic collaboration) fell short of identifying the types of collaboration being applied, such as inter-individual, inter-national, inter-institutional, etc. Hence, it has been recommended that further research be conducted "*in order to identify the types of these collaborations*" (Macias-Chapula & Mijangos-Nolasco, 2002). Macias-Chapula & Mijangos-Nolasco (2002) specifically recommend that a study be conducted in order to identify the inter-institutional/national, inter-national and North-South types of collaboration. From the foregoing, little is therefore known regarding the collaborative networks between the institutions, countries and regions as well as within these entities. For instance, is there collaboration between individuals within the same institution (domestic) or between several institutions (inter-institution)? Which institutions are actually jointly conducting HIV/AIDS research in E&S Africa? Do these collaborative efforts involve university and industry, or university and government laboratories, or industry and government laboratories? What is the extent of collaboration, both for local (domestic) and international collaboration?

4.4 Methods and procedures

This analysis was intended to provide insight into the patterns of research collaboration between individuals, institutions, and countries. It is worth noting that only ISI data was used to compare authorship patterns in this chapter. The number of authors per publication was used to determine the nature of authorship, i.e. single or multiple, while the institutional affiliation provided an insight into the form of institutional collaboration. An analysis of the author's country of origin, information that was obtained from the author's address Field, provided the basis for determining the nature of collaboration between the countries and other geographical regions. Integer counts of authors and articles were appropriately used to analyze publication frequencies by institution, authors and countries.

For the purposes of conducting this analysis on the collaborative patterns in HIV/AIDS research on E&S Africa, the co-authorship of HIV/AIDS papers was used as an indicator of research collaboration. Although Katz & Martin (1997) note that co-authorship is merely a partial indicator of collaboration, they nevertheless point out four key advantages of using the technique to measure collaboration, namely, its verifiability, stability over time, data availability and ease of measurement. They observe thus:

> *First, it is invariant and verifiable; given access to the same data set, other investigators should be able to reproduce the results. Secondly, it is a relatively inexpensive and practical method for quantifying collaboration. Furthermore, the size of sample that it is possible to analyze using this technique can be very large and the results should therefore be statistically more significant than those from case studies. Finally, some would argue that bibliometric studies are unintrusive and indeed non-reactive – that is, the measurement does not affect the collaboration process. This may be true in terms of an immediate effect but others have suggested that the results from a bibliometric investigation may influence collaboration practices over the longer term* (Katz & Martin, 1997: Multiple Authorship and Collaboration section, para 6).

Co-authorship has been used in several informetric studies to analyze research collaboration. For example, the approach has been used to study collaboration patterns in Indonesian nutrition research papers (Hartinah, Davis, Hydari & Kent, 2001:227), Estonian international co-operation in science in the 1990s (Lewison & Must, 2001), science in Africa (Narvaez-Berthelemot, Russell, Arvanitis, Waast & Gaillard, 2001:470), collaboration, growth, and development of Iranian Scientific publications from 1985 to 1999 (Osareh & Wilson, 2001), growth and collaboration trends in nuclear science research literature in India from 1980 to 1994 (Ravi, 2001) and to analyze the nature of research collaboration in biomedical sciences in 24 Latin American and Caribbean countries (Fernandez, Sancho, Morillo, Filippo & Gomez, 2003:66). Research collaboration patterns have also been measured using co-authorship by Rao & Raghavan (2003), Wagner & Leydesdorff (2003), Yoshikane & Kageura (2003), Persson, Glazel & Danell (2003), and Wang, Wu, Pan & Ma (2003). Co-authorship remains the most preferred indicator used to describe collaboration and co-operation in all areas of research (Gauthier, 1998).

The data collection procedures outlined in Chapter Three were followed and upon downloading data, and subjecting it to analysis using various computer software, the author, institutional and country collaboration patterns were determined. In order to determine the number of collaborating authors for each publication, the authors of each paper were counted and the figures recorded, accordingly, onto electronic spreadsheets prepared with the help of Microsoft Excel – version 2002. The nature of collaboration was determined by classifying the papers into either single or multiple authored papers, and according to the number of authors per paper, i.e. one-author, two-author, three-author, etc.

Data was also analyzed in order to:

- find out which foreign countries collaborate with E&S African countries
- examine inter-regional collaboration, i.e. collaboration among countries in the two regions of study
- identify collaborating individuals and institutions

The counting of institutional co-authorships considered the co-occurrence of two institutions in the address field of each record. A country was counted as many times as it appeared with another country in the record. To illustrate, consider the following information extracted from the address field (addresses of collaborating authors) of a record:

```
C1 Univ British Columbia, Ctr Dis Control, Vancouver, BC V5Z 1M9,
   Canada.
   Univ Washington, Dept Obstet & Gynecol, Seattle, WA 98195 USA.
   Univ Nairobi, Dept Med Microbiol, Nairobi, Kenya
   Kenya Med Res Inst, Ctr Microbiol Res, Nairobi, Kenya.
   Univ Manitoba, Dept Med Microbiol, Winnipeg, MB, Canada.
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Using the principle of calculating permutations (without repeating any set), and allocating a whole number to each, provides a total of 10 institutional collaborations which can be presented as follows:

1.	Univ British Columbia & Univ Washington	1
2.	Univ British Columbia & Univ Nairobi	1
3.	Univ British Columbia & Kenya Med Res Inst	1
4.	Univ British Columbia & Univ Manitoba	1
5.	Univ Washington & Univ Nairobi	1
6.	Univ Washington & Kenya Med Res Inst	1
7.	Univ Washington & Univ Manitoba	1
8.	Univ Nairobi & Kenya Med Res Inst	1
9.	Univ Nairobi & Univ Manitoba	1
10.	Kenya Med Res Inst & Univ Manitoba	1

The same approach was used to identify and determine collaboration between countries.

The analysis in this chapter also sought to measure the mean number of authors per paper (collaborative index), the collaborative coefficient (CC), expressed as the "*ratio of the number of collaborative papers to the total number of papers published in a domain during a fixed period of time*" (Rao & Raghavan 2003:233), and the degree of collaboration, which allowed us to check the extent of collaboration.

We also calculated the mean number of citations per author in order to measure the average impact of each author's work(s) as well as find out whether collaboration influences research impact.

Pajek computer software was mostly used to prepare network maps.

4.5 Presentation of findings

This section presents the findings under the following sub-headings:

1. Extent of collaboration:
    - Mean number of authors per co-authored paper
    - Degree of collaboration
    - Collaboration Coefficient
2. Collaborating institutions
3. Collaborating countries
4. Collaborating authors
5. Effect of research collaboration on research impact

4.5.1 Extent of collaboration

Rao & Raghavan (2003) identify three different measures commonly used to study collaboration, namely:

- The Collaborative index – mean number of authors per paper
- The degree of collaboration – proportion of single and multiple-author papers)
- The Collaborative Coefficient – the ratio of the total number of collaborative papers to the total number of papers published in a domain during a fixed period of time.

The study employed all three measures to compare and study the extent of HIV/AIDS research collaboration in E&S African countries. As has already been explained in Chapter Three, co-authorship (which, for the purposes of conducting this study, is used interchangeably with multiple-authorship) was used to measure research collaboration. Co-authorship was found to range between two and 202 authors. Thus, the highest number of authors who participated in writing a paper on HIV/AIDS was 202.

Table 4.2 shows the growth and distribution of single- and multiple-author papers from 1980 to 2005. This analysis was meant to evaluate the trends of single and multiple-author papers in order to examine and compare the trend of research collaboration, as opposed to research that is conducted individually. It can be seen that both single- and multiple-author papers grew over time for each country. For most countries, especially the 8 top ranking countries (i.e. South Africa, Uganda, Kenya, Tanzania, Zambia, Malawi, Zimbabwe and Ethiopia), the exponential growth of multiple-author HIV/AIDS papers is more clear. For instance, South Africa's multiple-author papers grew from 8 in 1983-1985 to 18 in 1986-1988 and thereafter to 57 in 1989-1991, while 1992-1994 recorded 97 papers. The trend continued with 1995-1997 contributing 171 papers, which grew to 412 and 624 papers in 1998-2000 and 2001-2003, respectively. The number of papers then dropped to 483 in 2004-2005. This trend is common in all the E&S African countries.

The total single- and multiple-author papers per year are presented in Fig. 4.1. The Figure shows that although multiple-author papers were many and appeared to rapidly grow from one year-period to the next, they occasionally grew at a lesser rate than single-authored papers.

When analyzing the rate at which the literature grew for both categories (i.e. single- and multiple-author papers), Fig. 4.1 shows that single-author papers increased by 350% (7 papers), from 2 papers between 1983-1985 to 9 papers from 1986-1988, while co-authored papers grew by an even larger percentage (677.8%) - from just 9 papers to 70 papers over the same time period. Paper-wise growth and corresponding percentage increments of single-author papers were as follows: 1986-1988/1989-1991 (30, 333.3%); 1989-1991/1992-1994 (41, 105.1%); 1992-1994/1995-1997 (40, 50.0%); 1995-1997/1998-2000 (147, 122.5%); 1998-2000/2001-2003 (51, 19.1%) while multiple-author papers grew as follows: 1986-1988/1989-1991 (218, 311.4%); 1989-1991/1992-1994 (288, 100.0%); 1992-1994/1995-1997 (276, 47.9%); 1995-1997/1998-2000 (458, 53.8%); 1998-2000/2001-2003 (579, 44.2%). Papers in both categories illustrated a downward trend between 2001-2003 and 2004-2005, with single-author papers dropping by 106 papers (33.3%) and multiple-author papers decreasing by 501 papers (27.5%).

Country	1980-1982		1983-1985		1986-1988		1989-1991		1992-1994		1995-1997		1998-2000		2001-2003		2004-2005		TOTAL		Unknown author(s)	GRAND TOTAL
	s	m	s	m	s	M	s	m	s	M	s	m	s	m	s	m	s	m	s	m		
South Africa	0	0	2	8	6	18	13	57	31	97	39	171	93	412	154	624	102	483	440	1870	3	2313
Uganda	0	0	0	0	1	6	3	44	15	109	12	132	41	191	36	280	27	227	135	989	0	1124
Kenya	0	0	0	1	1	16	10	55	9	105	19	147	35	178	16	215	14	155	104	872	0	976
Tanzania	0	0	0	0	0	8	2	30	3	77	11	128	27	156	28	203	13	139	84	741	0	825
Zambia	0	0	0	0	1	8	4	31	9	63	14	84	18	85	12	124	7	74	65	469	0	534
Malawi	0	0	0	0	0	1	2	10	3	25	7	65	15	91	18	145	12	111	57	448	0	505
Zimbabwe	0	0	0	0	0	5	2	29	3	51	6	65	14	85	14	124	15	89	54	448	0	502
Ethiopia	0	0	0	0	0	3	2	12	4	27	7	30	4	55	7	88	2	40	26	255	0	281
Botswana	0	0	0	0	0	0	0	1	0	3	2	0	7	16	20	38	11	35	40	93	0	133
Mozambique	0	0	0	0	0	0	0	2	1	5	0	9	1	9	2	14	5	8	9	47	0	56
Sudan	0	0	0	0	0	1	0	4	0	3	0	6	5	10	3	13	2	5	10	42	0	52
Swaziland	0	0	0	0	0	0	0	1	2	2	1	1	1	4	2	8	2	11	8	27	0	35
Namibia	0	0	0	0	0	1	0	1	0	3	2	4	1	6	3	5	0	2	6	22	0	28
Djibouti	0	0	0	0	0	0	1	6	0	4	0	4	1	4	0	2	0	2	2	22	1	25
Lesotho	0	0	0	0	0	0	0	0	0	0	0	2	1	3	3	4	0	4	4	13	0	17
Somalia	0	0	0	0	0	1	0	4	0	2	0	2	1	1	0	1	0	1	1	12	0	13
Angola	0	0	0	0	0	2	0	1	0	0	0	2	1	1	0	1	0	2	1	9	0	10
Eritrea	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	1	3	0	4
TOTAL*	**0**	**0**	**2**	**9**	**9**	**70**	**39**	**288**	**80**	**576**	**120**	**852**	**267**	**1310**	**318**	**1889**	**212**	**1388**	**1047**	**6382**	**4**	**7433**

Table 4.2: Growth and distribution of single and multiple-authored papers from 1980-2005

Key

S = Single-authored papers

M = Multiple-authored papers

TOTAL* - The totals include duplicate articles (i.e. articles belonging to two or more countries were counted as whole articles in each country)

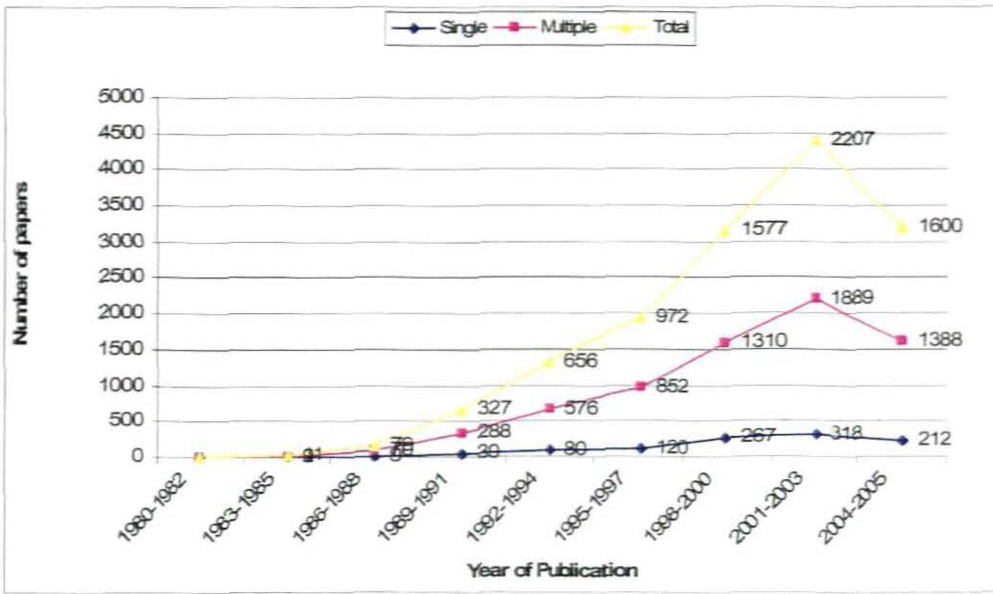


Fig. 4.1: Trend of single- and multiple-authored papers

Table 4.3 compares countries according to the total number of papers, number of papers with known authors, number of authors, mean number of authors per paper, degree of collaboration and collaborative coefficient. Papers with known authors refer to papers which had the personal names of authors. Those papers whose authors were unclear or not given were excluded from the analysis presented in column 2.

Overall, the results show that South Africa was ranked first in terms of the total number of papers (i.e. 2313 papers), out of which 2310 were authored by 9330 persons, thus producing an average number of 4.03 authors per paper. Second was Uganda, which yielded 1124 papers, all of which provided the personal names of authors who numbered 7374 in total. Kenya was third, while Tanzania, Zambia, Malawi, Zimbabwe, Ethiopia, Botswana and Sudan occupied positions three to ten, respectively.

As regards the degree of collaboration (comparing the percentage contributions of single-author papers and multiple-author papers), it can be seen that collaborative papers accounted for 85.9 % of the papers whose authors were given. In this respect, Somalia emerged as a country with the highest pattern of collaboration, with 92.3% of the country's papers resulting from joint authorship. This was followed by Djibouti whose co-authored papers comprised 91.7%, Ethiopia (90.8%), Angola (90.0%), Tanzania (89.8%), Kenya (89.3%), Zimbabwe (89.2%), Malawi (88.7%), Uganda (88.0%) and Zambia, which came tenth in the list of the top 10 countries with 87.8% collaborative papers.

Country	*Total Number of papers*	*Number of papers with known authors*	*Number of authors*	*Authors per paper*	*Degree of collaboration*				*Collaborative Coefficient*
					S	*%*	*M*	*%*	
South Africa	2313	2310	9330	4.03	440	19.05	1670	80.95	0.81
Uganda	1124	1124	7374	6.56	135	12.01	989	87.99	0.88
Kenya	976	976	6125	6.28	104	10.66	872	89.34	0.89
Tanzania	825	825	4805	5.82	84	10.18	741	89.82	0.90
Zambia	534	534	2974	5.57	65	12.17	469	87.83	0.88
Malawi	505	505	3058	6.06	57	11.29	448	88.71	0.89
Zimbabwe	502	502	2390	4.76	54	10.76	448	89.24	0.89
Ethiopia	281	281	1601	5.70	26	9.25	255	90.75	0.91
Botswana	133	133	446	3.35	40	30.08	93	69.92	0.70
Mozambique	56	56	292	5.21	9	16.07	47	83.93	0.84
Sudan	52	52	202	3.88	10	19.23	42	80.77	0.81
Swaziland	35	35	153	4.37	8	22.86	27	77.14	0.77
Namibia	28	28	143	5.11	6	21.43	22	78.57	0.79
Djibouti	25	24	162	6.48	2	8.33	22	91.67	0.88
Lesotho	17	17	94	5.53	4	23.53	13	76.47	0.76
Somalia	13	13	71	5.46	1	7.69	12	92.31	0.92
Angola	10	10	64	6.40	1	10.00	9	90.00	0.90
Eritrea	4	4	17	4.25	1	25.00	3	75.00	0.75
TOTAL*	**7433**	**7429**	**39301**	5.29	**1047**	14.09	**6382**	85.91	0.86

Table 4.3: Distribution of Papers by the average number of authors per paper, degree of collaboration and collaboration coefficient, 1980-2005

Total* = Duplicate entries are included in the analysis (i.e. same papers that appear under two or more countries are included in the Total figures)

The ratio of the co-authored papers to the total number of papers (otherwise known as the collaborative coefficient – CC) was highest in Somalia, which recorded 0.92. Other countries with high CCs were, in descending order, Ethiopia (0.91), Angola (0.90), Tanzania (0.90), Kenya (0.89), Malawi (0.90), Zimbabwe (0.89), Uganda (0.88), Zambia (0.88), Djibouti (0.88), Mozambique (0.84), South Africa (0.81), and Sudan (0.81). The rest of the countries had a CC that was less than 0.80. Unlike the findings of the analysis of the degree of collaboration, where the minimum ratio of co-authored papers stood at 0.75, the CC fell below that figure in the case of Botswana.

Another approach for measuring the extent of collaboration is to consider the number of papers that have been written by a certain number of authors [i.e. two, three, four, five, etc.] (Rao & Raghavan, 2003:234). As has been mentioned, the number of authors that were engaged in writing HIV/AIDS in E&S Africa ranged between 2 and 202. The findings are presented in Fig 4.2 which generally shows that two-author papers were the majority (832), followed by three-author papers which totaled 804, and three-author papers which numbered 703. There were 693 four-author papers, 586 five-author papers, 573 six-author papers, and 510 seven-author papers, etc. It was noted that the total number of papers fell as the number of authors per paper grew, which implies a reverse relationship between the number of papers and the number of authors participating in the writing of each paper.

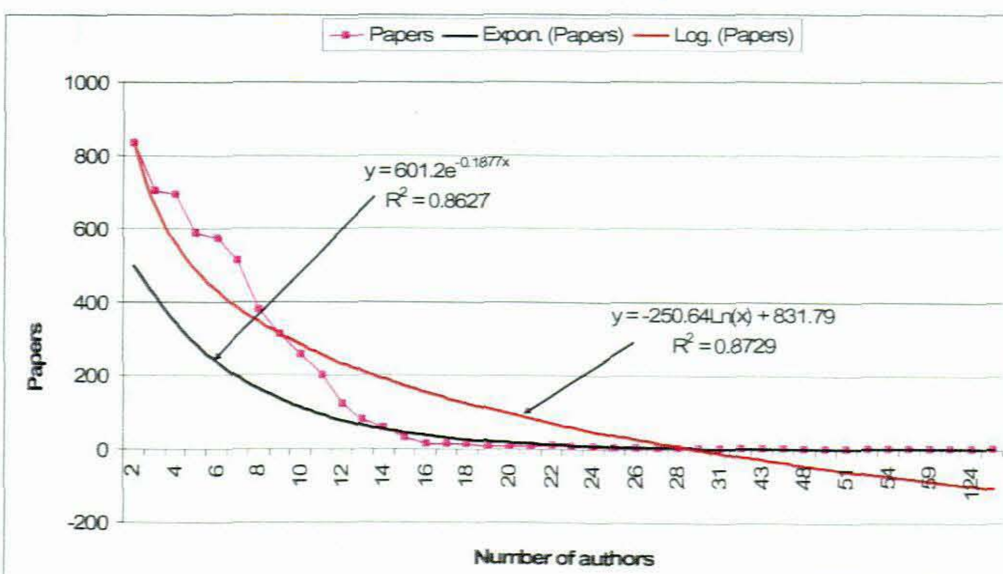


Fig 4.2: Distribution of multiple-authored papers by the number of authors per paper

Key: Expon. (Papers) – Exponential trendline
Log. (Papers) – Logarithmic trendline

4.5.2 Collaborating countries

Research collaboration between researchers from one country and those from another is increasingly becoming common and is subsequently encouraged for the purposes of knowledge and technology transfer. This section provides an analysis of co-authored papers in four parts, namely:

1. Papers co-authored within the same country in the two regions of study;
2. Papers co-authored between researchers from countries in E&S Africa but not within the same country;
3. Papers co-authored between E&S African countries and those from the rest of Africa; and
4. Papers co-authored between E&S African countries and countries outside Africa.

In this study, the first type of country collaboration has been termed **internal/local/domestic collaboration**, the second type **Sub-regional collaboration** while the third and fourth categories of collaboration have been labeled **Regional** and **Foreign** (or International) collaboration, respectively.

4.5.2.1 Internal/local/Domestic Collaboration

Table 4.4 illustrates internal and sub-regional co-authorships, within and between countries in E&S Africa. The Table shows that whereas Angola posted two co-author papers within the country, the country did not author any papers with any other E&S African country. Co-authorship amongst researchers in Botswana was relatively high, having equalled 34 out of 54 internally co-authored papers. Djibouti recorded only two co-author papers that were written by researchers within the country. There were no locally co-authored papers in the case of Eritrea. Ethiopia's internal co-authorship totaled 83, while Kenya posted 288. The distribution of internally co-authored papers for other countries was as follows: Lesotho (1), Malawi (160), Mozambique (11), Namibia (6), Somalia (1), and South Africa (813). Others are Sudan (10), Swaziland (2), Tanzania (214), Uganda (228), Zambia (105) and Zimbabwe (126). Table 5.4 presents a distribution of these internally co-authored papers as percentages of the total number of multiple-author papers in each country for the period 1980-2005. It was observed that South Africa had the highest number of internal co-authorships (813 or 43.5%). Although Kenya produced more co-authored papers (288) than

Malawi (160), Kenya's percentage contribution (i.e. 33.0%) was less than that of Malawi (35.7%). The same applies to the positional ranking of Uganda (228 or 23.1%) and Tanzania (214 or 28.9%).

4.5.2.2 Sub-regional collaboration

Concerning co-authorships between E&S Africa countries, Table 4.4 and Fig 4.3 show that Botswana jointly authored papers with South Africa (6), Lesotho (4), Swaziland (4) and one paper each with Kenya, Malawi, Namibia, Uganda, Zambia and Zimbabwe. Ethiopia's major partners in HIV/AIDS research were Uganda (3), South Africa (2) and Zimbabwe (2), while Kenya exhibited strong collaborative links with South Africa (14), Tanzania (12), Uganda (11) and Zambia (11). South Africa and Swaziland jointly authored 5 papers each with Lesotho. while Malawi's major collaborative partners were South Africa (12) and Zimbabwe (6). South Africa had the highest number of collaborating countries, namely: Zimbabwe (20), Kenya (14), Zambia (14), Uganda (9), Tanzania (7), Swaziland (6), Botswana (6), Lesotho (5), Ethiopia (2), Mozambique (2) and Namibia (2). These patterns of collaboration are presented in Fig 4.3.

Fig. 4.3: Sub-regional country collaboration network

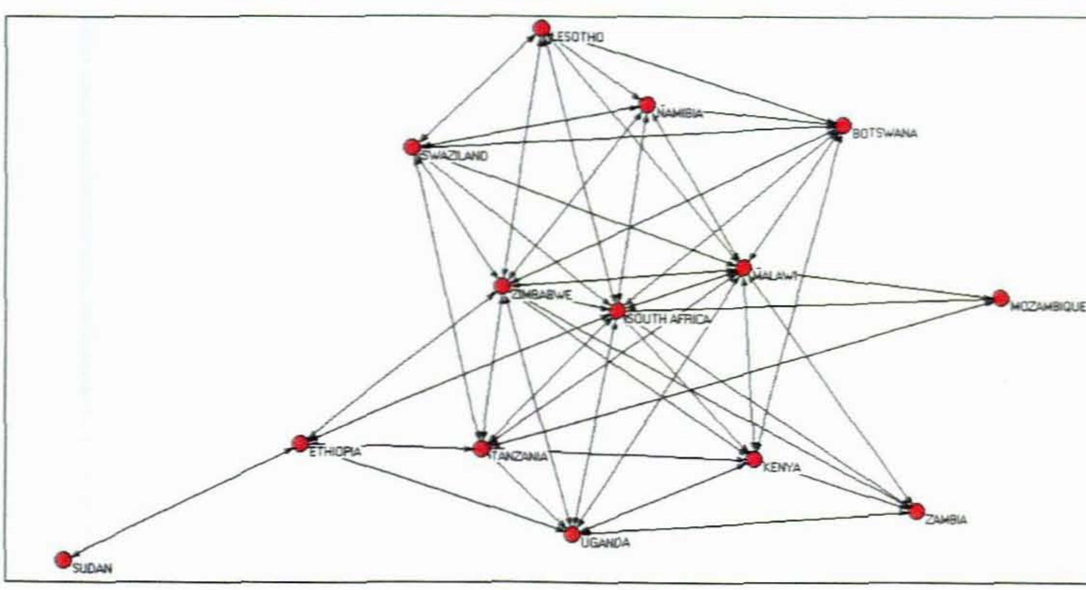


Table 4.4: Collaboration within and between E&S African countries

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	Angola	2	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-
2	Botswana		34	-	-	-	1	4	1	-	1	-	6	-	4	-	1	1	1
3	Djibouti			2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	Eritrea				0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	Ethiopia					83	-	-	-	-	-	-	2	1	-	1	3	-	2
6	Kenya						288	-	1	-	1	-	14	-	-	12	11	11	3
7	Lesotho							1	1	-	1	-	5	-	5	-	-	-	1
8	Malawi								160	1	-	-	12	-	2	3	4	4	6
9	Mozambique									11	-	-	2	-	-	1	-	-	-
10	Namibia										6	-	2	-	1	-	-	-	1
11	Somalia											1	-	-	-	-	-	-	-
12	South Africa												813	-	6	7	9	14	20
13	Sudan													10	-	-	-	-	-
14	Swaziland														2	1	-	-	2
15	Tanzania															214	9	-	5
16	Uganda																228	-	5
17	Zambia																	105	9
18	Zimbabwe																		126

Table 4.5: Percentage distribution of internal co-authorships

	1980-1982	1983-1985	1986-1988	1989-1991	1992-1994	1995-1997	1998-2000	2001-2003	2004-2005	TOTAL
Angola	0(0.00%)	0(0.00%)	1(50.00%)	0(0.00%)	0(0.00%)	1(50.00%)	0(0.00%)	0(0.00%)	0(0.00%)	2(22.22%)
Botswana	0(0.00%)	0(0.00%)	0(0.00%)	1(100.00%)	0(0.00%)	0(0.00%)	8(50.00%)	15(39.47%)	10(28.57%)	34(36.56%)
Djibouti	0(0.00%)	0(0.00%)	0(0.00%)	0(0.00%)	1(25.00%)	1(25.00%)	0(0.00%)	0(0.00%)	0(0.00%)	2(9.09%)
Eritrea	0(0.00%)	0(0.00%)	0(0.00%)	0(0.00%)	0(0.00%)	0(0.00%)	0(0.00%)	0(0.00%)	0(0.00%)	0(0.00%)
Ethiopia	0(0.00%)	0(0.00%)	1(33.33%)	3(25.00%)	8(29.63%)	2(6.67%)	17(30.91%)	27(30.68%)	25(62.50%)	83(32.55%)
Kenya	0(0.00%)	0(0.00%)	9(56.25%)	19(34.55%)	32(30.48%)	41(27.89%)	57(32.02%)	74(34.42%)	56(36.13%)	288(33.03%)
Lesotho	0(0.00%)	0(0.00%)	0(0.00%)	0(0.00%)	0(0.00%)	1(50.00%)	0(0.00%)	0(0.00%)	0(0.00%)	1(7.69%)
Malawi	0(0.00%)	0(0.00%)	0(0.00%)	0(0.00%)	7(28.00%)	29(44.62%)	31(34.07%)	58(40.00%)	35(31.53%)	160(35.71%)
Mozambique	0(0.00%)	0(0.00%)	0(0.00%)	0(0.00%)	0(0.00%)	3(33.33%)	1(11.11%)	3(21.43%)	2(25.00%)	9(19.15%)
Namibia	0(0.00%)	0(0.00%)	0(0.00%)	0(0.00%)	0(0.00%)	0(0.00%)	6(100.00%)	0(0.00%)	0(0.00%)	6(27.27%)
Somalia	0(0.00%)	0(0.00%)	0(0.00%)	0(0.00%)	0(0.00%)	0(0.00%)	1(100.00%)	0(0.00%)	0(0.00%)	1(8.33%)
South Africa	0(0.00%)	6(75.00%)	5(27.78%)	28(49.12%)	42(43.30%)	56(32.75%)	209(50.73%)	275(44.07%)	192(39.75%)	813(43.48%)
Sudan	0(0.00%)	0(0.00%)	1(100.00%)	3(75.00%)	0(0.00%)	1(16.67%)	1(10.00%)	3(23.08%)	1(20.00%)	10(23.81%)
Swaziland	0(0.00%)	0(0.00%)	0(0.00%)	0(0.00%)	0(0.00%)	0(0.00%)	0(0.00%)	0(0.00%)	2(18.18%)	2(7.41%)
Tanzania	0(0.00%)	0(0.00%)	1(12.50%)	9(30.00%)	35(45.45%)	47(36.72%)	49(31.41%)	47(23.15%)	26(18.71%)	214(28.88%)
Uganda	0(0.00%)	0(0.00%)	1(16.67%)	14(31.82%)	15(13.76%)	36(27.27%)	46(24.08%)	61(21.79%)	55(24.23%)	228(23.05%)
Zambia	0(0.00%)	0(0.00%)	2(25.00%)	7(22.58%)	9(14.29%)	25(29.76%)	15(17.65%)	29(23.39%)	18(24.32%)	105(22.39%)
Zimbabwe	0(0.00%)	0(0.00%)	0(0.00%)	9(31.03%)	12(23.53%)	15(23.08%)	28(32.94%)	41(33.06%)	21(23.60%)	126(28.13%)
Total	0(0.00%)	6(66.67%)	21(30.00%)	93(32.29%)	161(27.95%)	258(30.28%)	469(35.80%)	633(33.51%)	443(31.92%)	2084(32.65%)

Note: Percentages were derived from the total number of locally/domestically co-authored papers divided by the total number of multiple author papers, multiplied by 100.

4.5.2.3 Regional collaboration

The phrase 'regional collaboration' in this study refers to research collaboration between a country in the E&S Africa region and one from outside the region but within Africa. Data was analyzed in order to examine collaboration in HIV/AIDS research between countries in the E&S African region, and those countries from the rest of Africa, in order to compare collaboration within and outside E&S Africa.

E&S African country	Collaborating African country(ies) outside E&S Africa
Angola	-
Botswana	Cote D'Ivoire(1), Nigeria(1), Rwanda(1)
Djibouti	-
Eritrea	-
Ethiopia	Cameroon(1)
Kenya	Cameroon(9), Zaire(8), Benin(4), Burkina Faso(4), Cote D'Ivoire(3), Egypt(3), Ghana(3), Senegal(3), Gambia(2), Rwanda(2), Gabon(1)
Lesotho	Sierra Leone(1)
Malawi	Rwanda(1), Gambia(1)
Mozambique	Nigeria(1)
Namibia	-
Somalia	-
South Africa	Cote D'Ivoire(6), Gambia(4), Burkina Faso(3), Cameroon(3), Benin(1), Egypt(1), Gabon(1), Ghana(1), Nigeria(1), Rwanda(1), Sierra Leone(1), Tunisia(1)
Sudan	Egypt(6),
Swaziland	Sierra Leone(1)
Tanzania	Cameroon(3), Gambia(3), Burundi(2), Cote D'Ivoire(2), Guinea Bissau(1)
Uganda	Cameroon(4), Cote D'Ivoire(4), Rwanda(4), Egypt(3), Gambia(3), Zaire(1), Ghana(1), Nigeria(1),
Zambia	Cameroon(7), Benin(4), Rwanda(3), Senegal(2), Zaire(2), Burkina Faso(1), Congo(1), Mali(1), Niger(1), Nigeria(1), Chad(1), Togo(1), Egypt(1), Cote D'Ivoire(1)
Zimbabwe	Nigeria(3), Cote D'Ivoire(2), Rwanda(1), Zaire(1), Mali(1), Burkina Faso(1), Cameroon(1)

Table 4.6: Regional Countries collaborating with E&S African countries, with corresponding number of co-authored papers (in brackets)

Results show that Angola (as was the case in sub-regional collaboration) did not have any collaborative links with any African country outside E&S Africa. Similarly, Djibouti, Eritrea, Namibia and Somalia recorded no records in regional co-authorships. Botswana co-authored most papers in 2004, with Cote D'Ivoire (1), Nigeria (1) and Rwanda (1). Fig 4.4 is a visual map that represents the collaborative networks between E&S African and other African countries.

England (129), Belgium (65), Switzerland (40), Netherlands (38) and Thailand (15), are among the list of collaborators working with Kenya. Among major foreign countries co-operating with Lesotho is the USA (4), which also leads the pack of countries co-authoring HIV/AIDS papers in Malawi with 138 papers, followed by England (122), the Netherlands (20), Australia (12) and Switzerland (12), among others. The leading foreign countries in Mozambique's co-authorships are Sweden (7), Norway (6), USA (6), England (3) and Spain (3). Namibia exhibited her strongest co-authorship links with the USA (4), Germany (3) and England (2), while Somalia's strongest co-authorship partner was the USA (3). South Africa also exhibited its strongest links with the USA (352), followed by England (231), France (45), Switzerland (43) and Canada (38), among others. Sudan's and Swaziland's major collaborator was the USA, which contributed 6 and 8 papers with each of the two countries, respectively. Again, the USA (154) was the leading collaborator with Tanzania followed by England (93), Sweden (66) and Netherlands (40). Uganda's major contributing partners were the USA (284), England (124), Switzerland (37) and Italy (28), etc. Zambia co-authored 114 papers with England, 109 with the USA and 15 with Switzerland, to name a few. Lastly, Zimbabwe participated in authoring 87 papers in conjunction with the USA, 50 with England and 16 with Switzerland. This pattern of international collaboration is visually represented in Fig 4.5.

Fig. 4.5: International country collaboration network

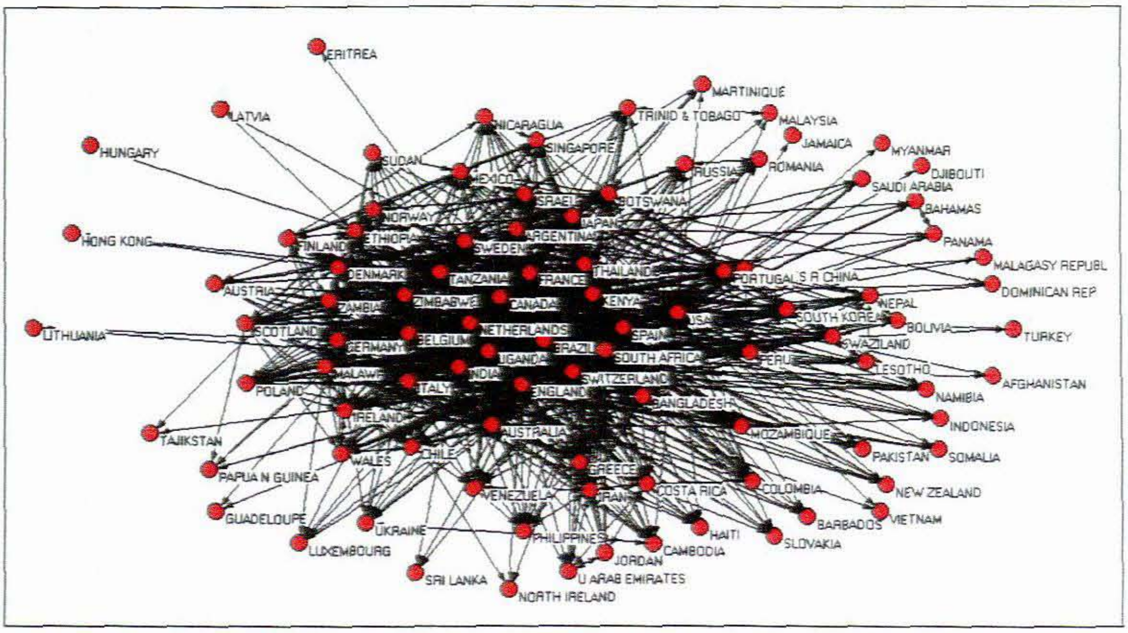


Table 4.7: Domestic, Regional and International co-authorships

	Number of collaborating countries				Top ranked International countries with corresponding co-authored papers
	D	R	I	TOTAL	
Angola	-	-	4	4	Sweden(2), Portugal(1), France(1), Italy(1)
Botswana	9	3	15	27	USA(54), Canada(7), England(5), Israel(4), Thailand(3), Netherlands(2), Japan(2), Switzerland(2), India(2)
Djibouti	-	1	1	2	USA(1)
Eritrea	-	-	1	1	Sweden(3)
Ethiopia	5	1	24	30	Netherlands(58), Sweden(45), France(14), England(14), USA(13), Norway(11), Belgium(5), Israel(5)
Kenya	8	11	37	56	USA(280), Canada(156), England(129), Belgium(65), Switzerland(40), Netherlands(38), Thailand(15), Italy(14)
Lesotho	6	1	9	15	USA(4), Switzerland(1), Bolivia(1), China(1), South Korea(1), Nepal(1), Peru(1), Portugal(1), Spain(1)
Malawi	10	2	22	34	USA(138), England(122), Netherlands(20), Australia(12), Switzerland(12), Luxembourg(10), France(8)
Mozambique	3	1	16	20	Sweden(7), Norway(6), USA(6), England(3), Spain(3), France(2), Switzerland(2), Belgium(1), Netherlands(1)
Namibia	6	0	5	11	USA(4), Germany(3), England(2), Japan(1), Lithuania(1)
Somalia	-	1	3	4	USA(3), Italy(2), Netherlands(1)
South Africa	12	12	51	75	USA(352), England(231), France(45), Switzerland(43), Canada(38), Germany(37), Netherlands(35)
Sudan	1	1	9	11	USA(6), Netherlands(2), France(2), Norway(1), Germany(1), Switzerland(1), Sweden(1), India(1), England(1)
Swaziland	7	1	10	18	USA(8), Switzerland(1), China(1), South Korea(1), Bolivia(1), Nepal(1), Peru(1), Portugal(1), Spain(1)
Tanzania	8	5	32	45	USA(154), England(93), Sweden(66), Netherlands(40), Norway(28), Germany(26), Denmark(21), Belgium(15)
Uganda	7	8	38	53	USA(284), England(124), Switzerland(37), Italy(28), Germany(25), France(23), Netherlands(19), Scotland(18)
Zambia	5	14	28	47	England(114), USA(109), Switzerland(15), Sweden(9), Belgium(9), Japan(7), Austria(7), Scotland(6), Norway(6)
Zimbabwe	11	7	27	45	USA(87), England(50), Switzerland(16), France(12), Denmark(12), Canada(11), Sweden(9), Belgium(9)

Key: D – Domestic; R – Regional; I – International

4.5.3 Collaborating Institutions

As was noted in the analysis of country collaboration, institutional collaboration was largely between institutions based in Africa and those from outside Africa. Local institutions published their papers mainly through international collaborations. The top institutional co-authorships for each country were as follows:

Angola: There were no major collaborating institutions since all collaborating institutions appeared only once. These include AGOSTINHO NETO UNIV (Angola), which co-authored one paper each with HOSP SANTA MARIA (Portugal) and INST PASTEUR (France), while LAB NACL SAUDE PUBL (Angola) produced one paper each with MATERN LUCRECIA PAIM (Angola), UNIV PARMA (Italy), UNIV ROMA LA SAPIENZA (Italy), UNIV SASSARI (Italy), and the WHO (Angola).

Botswana: Botswana's top collaborating institutions, in descending order, include the MINIST HLTH, Botswana, and the CTR DIS CONTROL & PREVENT, USA (32); BOTUSA PROJECT, Botswana, and the CTR DIS CONTROL & PREVENT, USA (16); HARVARD UNIV and PRINCESS MARINA HOSP (10); BOTUSA TB PROJECT, Botswana, and CTR DIS CONTROL & PREVENT, USA (8); and NYANGABGWE HOSP, Botswana, and CTR DIS CONTROL & PREVENT (8).

Djibouti: Cooperation between the USN MED RES UNIT (Egypt) and the UNIV MARYLAND (USA) yielded 9 papers, while DIRECT TECH SANTE (Djibouti and South Africa) and the UNIV MARYLAND produced 4. Three papers were co-published by CABINET PRIVE MED GEN (South Africa) and the UNIV MARYLAND (USA).

Eritrea: UNIV ASMARA, Eritrea and SWEDISH INST INFECT DIS CONTROL, Sweden (2); UNIV ASMARA, Eritrea and KAROLINSKA INST, Sweden (2); UNIV ASMARA, Eritrea and KAROLINSKA HOSP, Sweden (1); SWEDISH INST INFECT DIS CONTROL, Sweden and KAROLINSKA INST, Sweden (1); SWEDISH INST INFECT DIS CONTROL, Sweden and KAROLINSKA HOSP, Sweden (1); and KAROLINSKA INST, Sweden and KAROLINSKA HOSP, Sweden (1).

Ethiopia: Key collaborators were ETHIOPIAN HLTH & NUTR RES INST, Ethiopia and UNIV AMSTERDAM, UK (50); MUNICIPAL HLTH SERV, Netherlands and ETHIOPIAN HLTH & NUTR RES INST, Ethiopia (33); MUNICIPAL HLTH SERV and UNIV AMSTERDAM (31); the UNIV ADDIS ABABA, Ethiopia and KAROLINSKA INST, Sweden (26); the ETHIOPIAN HLTH & NUTR RES INST and the UNIV ADDIS ABABA (25); and the UNIV ADDIS ABABA and UNIV AMSTERDAM (17).

Kenya: The UNIV NAIROBI, Kenya, co-authored 426 papers with the UNIV WASHINGTON, USA followed by the UNIV NAIROBI and UNIV MANITOBA, Canada (248); UNIV WASHINGTON and FRED HUTCHINSON CANC RES CTR (172); COAST PROV GEN HOSP and UNIV WASHINGTON (107); UNIV MANITOBA and UNIV WASHINGTON (97); and the UNIV NAIROBI and the FRED HUTCHINSON CANC RES CTR (60).

Lesotho: UNIV SWAZILAND, Swaziland, and UNIV BOTSWANA, Botswana (4); UNIV BOTSWANA and UNIV CALIF SAN FRANCISCO, USA (4); and MINIST HLTH and WORLD HLTH ORG (3).

Malawi: UNIV MALAWI and JOHNS HOPKINS UNIV (80); UNIV MALAWI and UNIV LIVERPOOL (70); UNIV MALAWI and UNIV N CAROLINA (46); LILONGWE CENT HOSP and UNIV N CAROLINA (30); UNIV MALAWI and RUTGERS STATE UNIV (25); and RUTGERS STATE UNIV and JOHNS HOPKINS UNIV (25); UNIV LIVERPOOL and COLL MED (25).

Mozambique: MINIST SAUDE and HOSP CLIN BARCELONA (4); UNIV EDUARDO MONDLANE and HOSP CENT MAPUTO (4); KAROLINSKA INST and UNIV STOCKHOLM (4); EDUARDO MONDLANE UNIV and ULLEVAL HOSP (3); MINIST HLTH and MINIST SAUDE (3).

Namibia: UNICEF WINDHOEK and UNIV MARYLAND (6); UNIV NAMIBIA and UNIV MARYLAND (6); UNIV NAMIBIA and UNICEF WINDHOEK (3); and MINIST HLTH and WHO (3).

Somalia: MINIST HLTH and USN (2). Other collaborations recorded one posting each.

South Africa: S AFRICAN INST MED RES and UNIV WITWATERSRAND (80); MRC AND UNIV NATAL (53); UNIV WITWATERSRAND AND EMORY UNIV (40); UNIV STELLENBOSCH AND TYGERBERG HOSP (39); CHRIS HANI BARAGWANATH HOSP and UNIV WITWATERSRAND (38); and UNIV NATAL and COLUMBIA UNIV (32).

Sudan: MINIST HLTH SUDAN and USN, Egypt (8); NATL HLTH LAB and UNIV KHARTOUM (5); UNIV KHARTOUM and UNIV OSLO (3); UNIV KHARTOUM and KHARTOUM TEACHING HOSP (3); and OMDURMAN MIL HOSP and USN, Egypt (3).

Swaziland: UNIV SWAZILAND and UNIV BOISIWANA (4); UNIV SWAZILAND and UNIV CALIF SAN FRANCISCO (4); UNIV BOISIWANA and UNIV CALIF SAN FRANCISCO (4); and MINIST HLTH and MRC (3).

Tanzania: MUHIMBILI UNIV and HARVARD UNIV (222); MUHIMBILI UNIV and KAROLINSKA INST (64); MUHIMBILI UNIV COLL HLTH SCI and HARVARD UNIV (58); MUHIMBILI MED CTR and HARVARD UNIV (46); MAKERERE UNIV and JOHNS HOPKINS UNIV (44); AFRICAN MED & RES FDN AND NATL INST MED RES (34); and AFRICAN MED & RES FDN and UNIV LONDON LONDON SCH HYG & TROP MED (32).

Uganda: MAKERERE UNIV and JOHNS HOPKINS UNIV (214); MAKERERE UNIV and CASE WESTERN RESERVE UNIV (154); MAKERERE UNIV and COLUMBIA UNIV (107); MAKERERE UNIV and UGANDA VIRUS RES INST (95); COLUMBIA UNIV and JOHNS HOPKINS UNIV (73); UGANDA VIRUS RES INST and JOHNS HOPKINS UNIV (62); CASE WESTERN RESERVE UNIV and UNIV HOSP CLEVELAND (48); and MAKERERE UNIV and NIAID (44).

Zambia: TROP DIS RES CTR and UNIV ALABAMA (33); UNIV ZAMBIA and UNIV ALABAMA (32); CTR INFECT DIS RES ZAMBIA and UNIV ALABAMA

(30); UNIV TEACHING HOSP and UNIV ALABAMA (24); UNIV ZAMBIA and UNIV TEXAS (19); ZAMBIAN MINIST HLTH and UNIV ALABAMA (17); UNIV ZAMBIA and UNIV TEACHING HOSP (16); and the UNIV ZAMBIA and ST BARTHOLOMEWS & ROYAL LONDON SCH MED & DENT (13).

Zimbabwe: UNIV ZIMBABWE, Zimbabwe, and STANFORD UNIV, USA (59); UNIV ZIMBABWE and UNIV CALIF SAN FRANCISCO, USA (23); UNIV ZIMBABWE and UNIV WASHINGTON, USA (22); UNIV ZIMBABWE and BIOMED RES & TRAINING INST, Zimbabwe (22); UNIV ZIMBABWE and JOHNS HOPKINS UNIV, USA (18); UNIV ZIMBABWE and MINIST HLTH (14); UNIV ZIMBABWE and JOHNS HOPKINS BLOOMBERG SCH PUBL HLTH (14); UNIV ZIMBABWE and LONDON SCH HYG & TROP MED (13); and UNIV ZIMBABWE and ROYAL VET & AGR UNIV (12).

Table 4.8: Institutional co-authorships			
Rank	Institution A	Institution B	No. of Papers
1	UNIV NAIROBI	UNIV WASHINGTON	426
2	UNIV NAIROBI	UNIV MANITOBA	248
3	MUHIMBILI UNIV	HARVARD UNIV	222
4	MAKERERE UNIV	JOHNS HOPKINS UNIV	214
5	FRED HUTCHINSON CANC RES CTR	UNIV WASHINGTON	189
6	CASE WESTERN RESERVE UNIV	MAKERERE UNIV	154
7	COAST PROV GEN HOSP	UNIV WASHINGTON	107
7	MAKERERE UNIV	COLUMBIA UNIV	107
8	UNIV MANITOBA	UNIV WASHINGTON	97
9	MAKERERE UNIV	UGANDA VIRUS RES INST	95
10	S AFRICAN INST MED RES	UNIV WITWATERSRAND	88
11	UNIV MALAWI	JOHNS HOPKINS UNIV	80
12	JOHNS HOPKINS UNIV	COLUMBIA UNIV	75
13	JOHNS HOPKINS UNIV	NIAID	72
14	UNIV MALAWI	UNIV LIVERPOOL	70
15	MUHIMBILI UNIV	KAROLINSKA INST	64
16	UGANDA VIRUS RES INST	JOHNS HOPKINS UNIV	62
17	UNIV NAIROBI	FRED HUTCHINSON CANC RES CTR	60
18	UNIV ZIMBABWE	STANFORD UNIV	59
18	MUHIMBILI UNIV COLL HLTH SCI	HARVARD UNIV	58
19	CTR DIS CONTROL & PREVENT	WHO	55
20	MRC (South Africa)	UNIV NATAL	53
21	CASE WESTERN RESERVE UNIV	UNIV HOSP CLEVELAND	51
22	MUHIMBILI MED CTR	HARVARD UNIV	46
22	UNIV MALAWI	UNIV N CAROLINA	46
23	MAKERERE UNIV	NIAID	44
23	UNIV NAIROBI	KENYA GOVT MED RES CTR	44
24	UNIV MANITOBA	UNIV TORONTO	41
26	UGANDA VIRUS RES INST	COLUMBIA UNIV	40
26	UNIV NAIROBI	UNIV TORONTO	40
26	UNIV WITWATERSRAND	EMORY UNIV	40
27	UNIV NAIROBI	COAST PROV GEN HOSP	39
27	UNIV STELLENBOSCH	TYGERBERG HOSP	39
28	UNIV WITWATERSRAND	CHRIS HANI BARAGWANATH HOSP	38
29	MULAGO HOSP	CASE WESTERN RESERVE UNIV	37
30	AFRICAN MED & RES FDN	NATL INST MED RES	34
30	UNIV NAIROBI	STATE UNIV GHENT	34
31	UNIV ALABAMA	TROP DIS RES CTR	33
31	UNIV NAIROBI	UNIV OXFORD	33
31	UNIV ZIMBABWE	STANFORD UNIV	33
32	CTR DIS CONTROL & PREVENT	KENYA GOVT MED RES CTR	32
32	KAROLINSKA INST	SWEDISH INST INFECT DIS CONTROL	32
32	UNIV NATAL	COLUMBIA UNIV	32
32	UNIV WITWATERSRAND	NATL INST VIROL	32
32	UNIV ZAMBIA	UNIV ALABAMA	32
33	AFRICAN MED & RES FDN	UNIV LONDON	31
33	UNIV CAPE TOWN	MRC	31

4.5.4 Collaborating authors

Figures 4.6 to 4.10 provide a time analysis of author collaboration from 1981 to 2005. The 5-year time slice was chosen so that the analysis could produce a reasonable number of clusters (herein sometimes referred to networks) that could be used to draw generalized conclusions as well as check for shifts in partnerships within a reasonably short time period. A summary of the network threshold settings is given under each Figure. Different citation thresholds were set for each time analysis in order to produce manageable networks. Fig 4.6 shows that there were two author networks that met the citation threshold requirements, and that several individual authors met the set requirements but produced no networks. Fig 4.7 provides the authors' collaborative networks between 1986 and 1990. The illustration indicates that there were five major networks (i.e. networks that consisted of over 6 authors) that emerged during this period. The largest network comprised 15 authors, including Plummer FA, Ndinya-Achola JO, Cameron DW, Plourde P, Wainberg MA and others. The geographic research focus area of these authors was Kenya. Also worth noting is the absence of the two author networks of 1981-1985, which therefore suggests that all the 11 1986-1990 author networks were new. The 1991-1995 year-period yielded a total of 15 author networks. The largest collaborative network stemmed from three authors, namely, Biryahwaho B, Delwart EL and Esparza J, who produced over twenty links each. Except for two networks (marked A and B and circled) which comprised names of some authors who had featured in the previous year-period's collaborative network, the networks that met the set threshold requirements for 1991-1995 year-period were mainly new. Networks A and B, however, reveal that the key players were Gilks C in network A, and Plummer FA, Nagelkerke NJD, Brunham RC, Ndinya-Achola JO, and Piot P in network B.

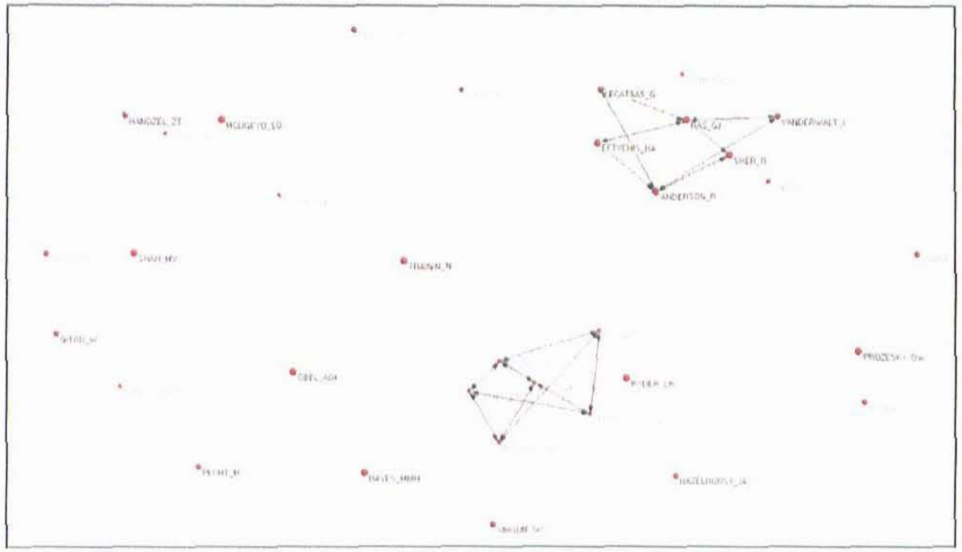


Fig. 4.6: Author Collaboration networks, 1981-1985

1-year slices	*c | cc | ccv*	*space*	*nodes*	*links*
1981-1981	*0 | 0 | 0.15*	*0*	*0*	*0*
1982-1982	*0 | 0 | 0.15*	*0*	*0*	*0*
1983-1983	*0 | 0 | 0.15*	*10*	*10*	*10*
1984-1984	*0 | 0 | 0.15*	*28*	*28*	*53*
1985-1985	*0 | 0 | 0.15*	*11*	*11*	*16*

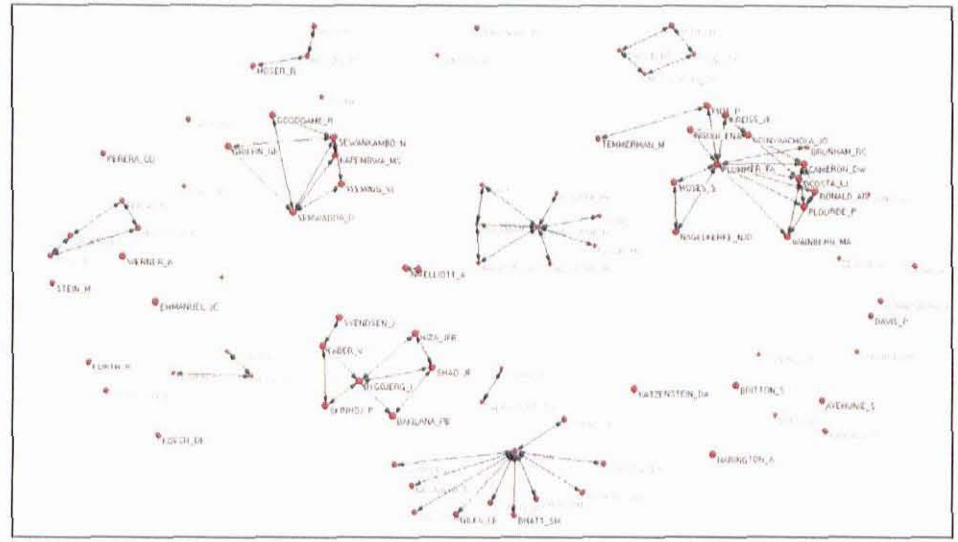
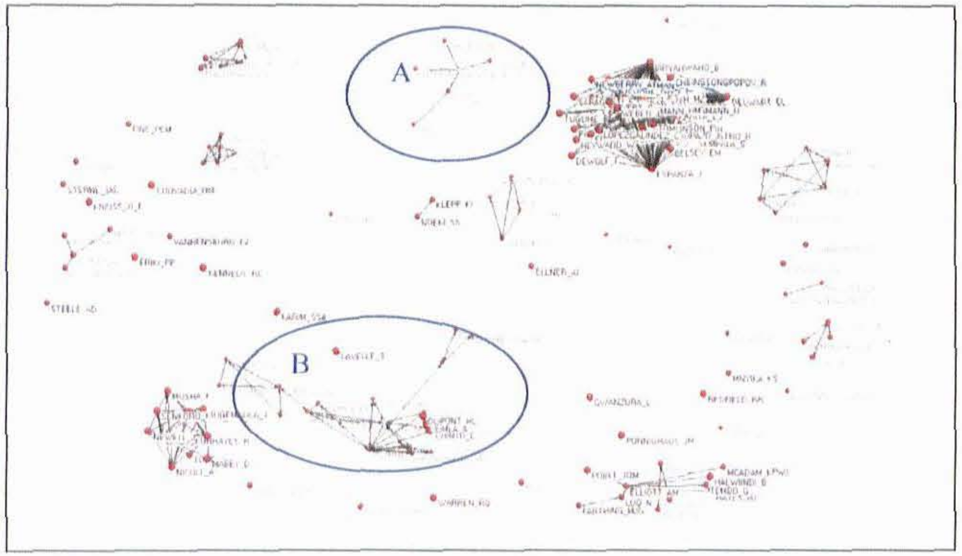


Fig. 4.7: Author Collaboration networks, 1986-1990

1-year slices	*c | cc | ccv*	*space*	*nodes*	*links*
1986-1986	*2 | 2 | 0.15*	*40*	*4*	*1*
1987-1987	*2 | 2 | 0.15*	*139*	*14*	*17*
1988-1988	*2 | 2 | 0.15*	*223*	*16*	*19*
1989-1989	*2 | 2 | 0.15*	*303*	*33*	*42*
1990-1990	*2 | 2 | 0.15*	*486*	*82*	*152*



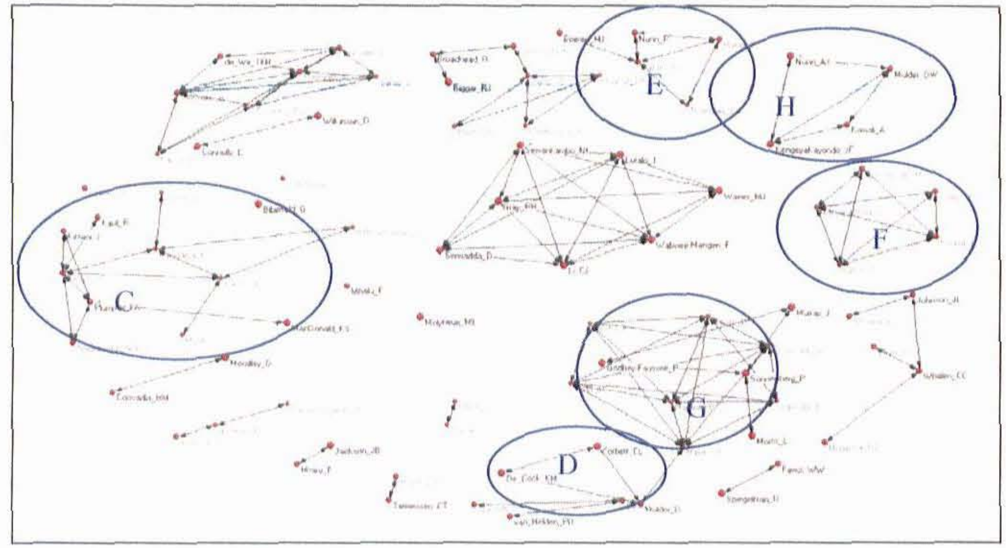


Fig. 4.8: Author Collaboration networks, 1991-1995

1-year slices	*c | cc | ccv*	*space*	*nodes*	*links*
1991-1991	*3 | 3 | 0.15*	*679*	*27*	*32*
1992-1992	*3 | 3 | 0.15*	*791*	*30*	*36*
1993-1993	*3 | 3 | 0.15*	*922*	*45*	*81*
1994-1994	*3 | 3 | 0.15*	*1229*	*106*	*1190*
1995-1995	*3 | 3 | 0.15*	*1571*	*80*	*55*

Fig. 4.9: Author Collaboration networks, 1996-2000

1-year slices	*c | cc | ccv*	*space*	*nodes*	*links*
1996-1996	*4 | 4 | 0.15*	*1362*	*19*	*6*
1997-1997	*4 | 4 | 0.15*	*1654*	*43*	*41*
1998-1998	*4 | 4 | 0.15*	*1728*	*44*	*12*
1999-1999	*4 | 4 | 0.15*	*2084*	*72*	*56*
2000-2000	*4 | 4 | 0.15*	*2474*	*84*	*37*

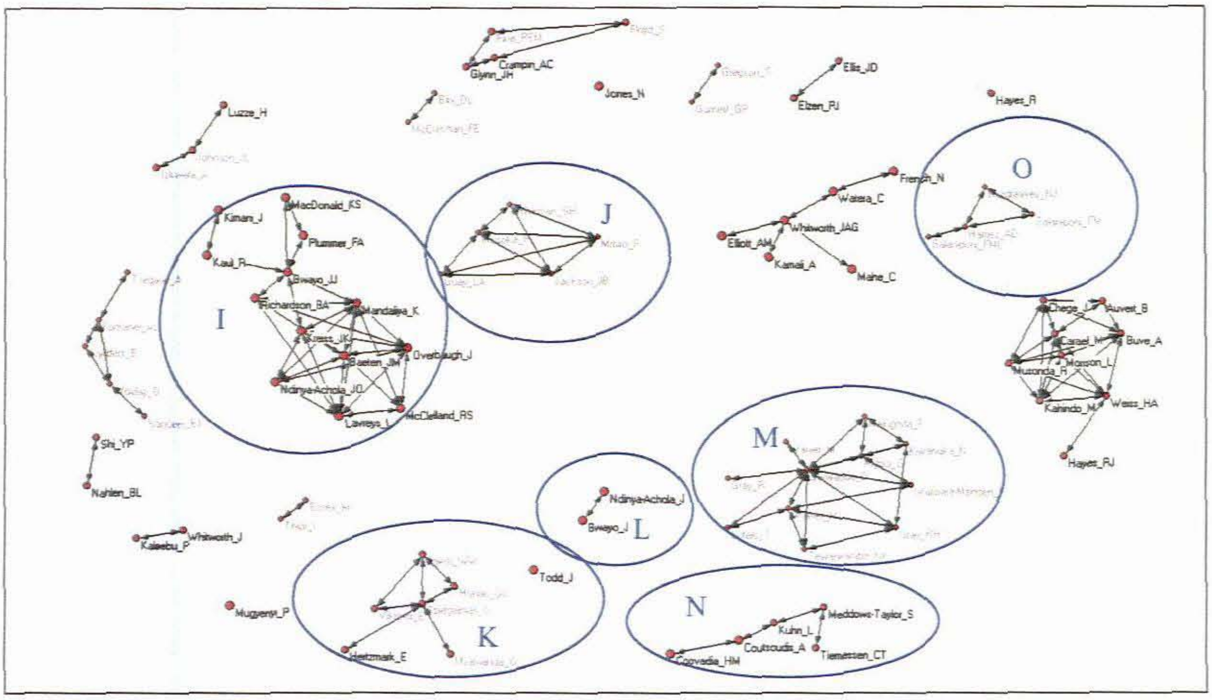


Fig. 4.10: Author Collaboration networks, 2001-2005

1-year slices	*c | cc | ccv*	*space*	*nodes*	*links*
2001-2001	*5 | 5 | 0.15*	*2671*	*69*	*54*
2002-2002	*5 | 5 | 0.15*	*2848*	*55*	*19*
2003-2003	*5 | 5 | 0.15*	*3092*	*41*	*15*
2004-2004	*5 | 5 | 0.15*	*3692*	*70*	*50*
2005-2005	*5 | 5 | 0.15*	*3128*	*29*	*14*

Fig 4.9's author collaborative network consists of a total of 16 networks, with several names of authors that appeared in the previous year-period (see Fig 4.6) featuring prominently. The networks that contain previously active collaborators are marked C-H. A notable observation derived from these networks is the participation of new authors that previously had either not featured anywhere (so to speak), or partnered with other authors in different collaborative activities. For instance, some names in network C (e.g. Plummer FA, Nagelkerke NJD, Ndinya-Achola JO, Mandaliya K, etc) formed a part of network B in the previous year-period. The new names in network C include Kimani J, MacDonald KS, and Moses S. Generally, each of these networks witnessed the entry of new names. One other notable observation that can be made is the split of network B into two networks in 1996-2000 (i.e. C and F). It can

also be seen that several new networks emerged in 1996-2000 as illustrated by the unmarked ones. Most of these networks remained in place in the first-half of this decade (2001-2010). Fig 4.10 provides 18 co-authorship networks for the period 2001-2005. Several of these networks (7/18) existed in, or comprised names of, authors who had formed some of the networks between 1996 and 2000. These are marked I-O. It should, however, be noted that most of these networks contained some or most names that did not feature in the previous year-period(s). Take for instance network N. The network was thought to have originated from the network that is to the immediate left of network D in Fig 4.9. At the time, the network contained two names (i.e. Martin DJ and Tiemessen CT) in 1996-2000. By 2001-2005, the number of the participating authors had grown to 5. Four of the names were new. Similarly, network K comprised two names (i.e. Fawzi WW and Spiegelman D) in 1996-2000. This pattern of previously existing authors sometimes disappearing from the scene with new ones entering into partnerships with a few of the remaining authors is true in most networks throughout the period of study.

Fig 4.11 provides a pictorial representation of several author collaborative networks in E&S Africa for the entire period of study (i.e. 1980-2005). The presentation provides only those authors that met the threshold requirements of 7 citations, 7 co-citations and a co-citation coefficient of 0.2. There were a total of 16 networks labeled A to O, in descending order (i.e. according to the number of authors in each network). The Figure shows that the sizes of the networks ranged from 2 to 48 authors. It identifies the largest network, i.e. A, as consisting of 48 authors, while the smallest network(s) comprises 2 authors.

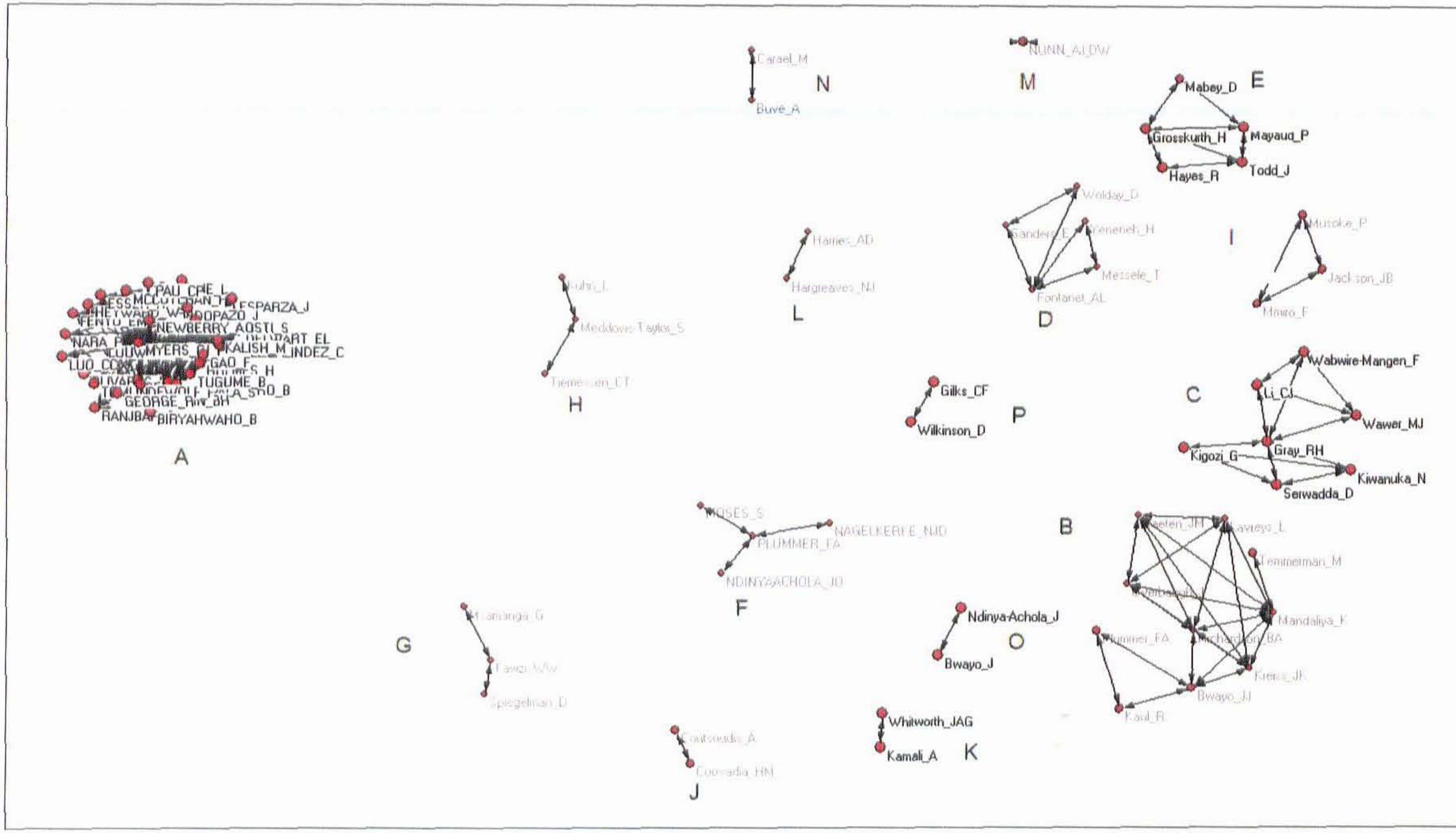


Fig 4.11: Author Collaboration Networks, 1980-2005
Threshold: c = 7, cc=7, ccv = 20 (or .20), nodes = 103, E = 1194

In considering the composition of the networks, it was found that network A consisted of authors from a number of different institutions and countries. It has the largest number of authors as well as the broadest geographical coverage. The authors' country and institutional affiliation include, but are not limited to, South Africa (e.g. Bachmann HM, University of the Orange Free State, Dept of Community Health; and Holmes H, University of the Western Cape, Faculty of Dentistry), Sweden (e.g. Albert J., Karolinska Inst, Swedish Inst Infect Dis Control & Microbiol, Dept Virol,; Fenyo EM., Karolinska Inst, Microbiol & Tumorbiol Ctr.) and the USA (e.g. Gao F., Duke Univ, Med Ctr, Dept Med.; Hahn BH, Univ Alabama, Dept Med.; Korber B., Los Alamos Natl Lab.; Delwart EL, Blood Syst Res Inst.; Mullins JI, Univ Washington, Sch Med, Dept Microbiol.). Others include Holmes, H. (Imperial Coll Sch Med, Chelsea & Westminster Hosp, Dept Immunol, London, England), Kaleebu P. (Uganda Virus Res Inst, MRC, Programme AIDS Uganda, Entebbe, Uganda), Lopez-Galindez C. (Inst Salud Carlos III, Ctr Nacl Microbiol, Madrid, Spain), Luo CC (Zhejiang Univ, Key Lab Mol Design & Nutr Engn, Ningbo Inst Technol, Ningbo, China), Osmanov S (WHO, UNAIDS HIV Vaccine Initiat, Geneva, Switzerland), Saragosti S (INSERM, IMEA, Paris, France), and Esparza J (WHO, UNAIDS HIV Vaccine Initiat, Geneva, Switzerland). The authors' research interest was focused on Uganda.

Network B, which is the second largest author network, consisted of ten authors who met the threshold requirements. They include Baeten JM (Univ Washington, Dept Epidemiol, Seattle, USA), Bwayo. J (Univ Nairobi, Dept Med Microbiol, Mombasa, Kenya), Kreiss JK (IARTP, Seattle, USA), Lavreys L (Univ Washington, Dept Epidemiol, Seattle, USA), Mandaliya K (Coast Prov Gen Hosp, Mombasa, Kenya), Overbaugh J (Fred Hutchinson Canc Res Ctr, Div Human Biol, Seattle, USA), and Plummer FA (University of Manitoba, Dept of Medical Microbiology, Canada). Others in this collaborative network are Richardson BA (Richardson BA (Univ Washington, Dept Biostat, Seattle, USA) and Temmerman M (State Univ Ghent, Dept Obstet & Gynaecol, ICRH, Ghent, Belgium). This group of authors mainly focused on HIV/AIDS in Kenya.

Seemingly, the formation of each author network in Fig. 4.11 was determined by the country of research. Network C whose focus was Uganda brought together authors from the USA and Uganda. These authors include Kiwanuka N (Uganda Virus Res Inst, Rakai Project, Entebbe, Uganda), Wawer MJ (Columbia Univ, Mailman Sch Publ Hlth, New York, USA), Wabwire-Mangen F (Makerere Univ, Inst Publ Hlth, Kampala, Uganda), Gray RH (Johns Hopkins Univ, Bloomberg Sch Publ Hlth, Dept Populat & Family Hlth Sci, Baltimore, USA) and Serwadda D (Johns Hopkins University, USA). Similarly, Uganda was the country of focus in network I, where the main players were Jackson JB (Johns Hopkins University, Baltimore, USA), Mmiro F (Makerere University, Dept Obstet & Gynaecol., Kampala, Uganda) and Musoke P (Makerere Med Sch., Dept Paediat & Child Hlth, Kampala, Uganda).

Whereas network D focused on Ethiopia, networks' E's and G's research activities centred on Tanzania, while network F concentrated on HIV/AIDS research in Kenya. The key participating collaborators in Ethiopia include Fontanet AL (Inst Pasteur, Emerging Dis Epidemiol Unit, Paris, France) and Wolday D (Ethiopian Hlth & Nutr Res Inst, EthioNetherlands AIDS Res Project, Addis Ababa, Ethiopia), among others. Tanzania's key collaborators in network E are Mayaud P (Univ London London Sch Hyg & Trop Med, Dept Infect & Trop Dis, London, England), Todd J (Univ London London Sch Hyg & Trop Med, London, England), Hayes RJ (Univ London London Sch Hyg & Trop Med, Dept Infect & Trop Dis, London, England), Mabey D (Univ London London Sch Hyg & Trop Med, Dept Infect & Trop Dis, Clin Res Unit, London, England), and Grosskurth H (Univ London London Sch Hyg & Trop Med, Dept Infect & Trop Dis, London, England). Network G has Msamanga G (Muhimbili Univ, Coll Hlth Sci, Dept Community Hlth, Dar Es Salaam, Tanzania) and Fawzi W (Harvard Univ, Sch Publ Hlth, Dept Nutr, Boston, USA). Moses S (University of Manitoba, Dept Med Microbiol Winnipeg, Canada), Plummer FA (University of Manitoba, Dept of Med Microbiol, Canada), Ndinya-Achola JO (University of Nairobi, Kenya) and Nagelkerke NJD (University of Manitoba, Dept of Med Microbiol, Canada) are the key players in network F whose focus is Kenya.

Other networks (J-P) largely consisted of two collaborators, and their main countries of research focus were as follows: J – South Africa, K – Uganda, L – Malawi, M – Uganda, N – Zambia, and O – Kenya. Although their centers of research activity were not clearly identified in this study, each group of authors can be said to be involved in research in the countries being researched. The results also show that Uganda produced the highest number of author networks (i.e. 5), followed by Kenya (3) while South Africa and Tanzania produced two networks each. Ethiopia, Malawi and Zambia were represented in one collaborative network each.

The highest contribution between two authors came from Ndinya-Achola JO and Plummer FA, who contributed 46 papers, followed by network C's Wawer MJ and Serwadda D (44), Gray RH and Serwadda D (43), and Gray RH and Wawer MJ (42). The rest of the top 10 two-author collaborators were as follows: Richardson BA and Kreiss JK (39); Overbaugh J and Kreiss (38); Mandaliya K and Kreiss (38); Mmiro F and Jackson JB (37); Plummer FA and Bwayo JJ (36); Plummer FA and Negelkerke NJD (32); and Lavreys L and Mandaliya K (32), etc.

4.5.5 Influence of collaboration on the impact of HIV/AIDS papers

Table 4.9 compares the total number of papers that were authored by *x* number of authors with the total number of citations received in each category. The Table shows that there were a total of 946 single-author (one-author) papers. This category received a total of 3295 citations, or 3.48 cites per paper. The distribution pattern of the average cites per paper for the other categories were as follows: two-author (5.98), three-author (6.88), four-author (7.77), and five-author (9.45), etc. When cumulated, multiple-author papers totaled 5417. These papers received a total of 69088, thereby generating 12.75 citations per paper.

Table 4.9: Influence of collaboration on average impact of HIV/AIDS papers*

No. of authors	*No. of Papers (Total)*	*Total cites*	*Av cites/ paper*	*No. of authors*	*No. of Papers (Total)*	*Total Cites*	*Av cites/ paper*
1	946	3295	3.48	23	6	170	28.33
2	832	4973	5.98	24	4	85	21.25
3	703	4836	6.88	25	1	4	4.00
4	693	5386	7.77	26	1	1	1.00
5	586	5539	9.45	27	1	3	3.00
6	573	6675	11.65	28	3	118	39.33
7	510	6241	12.24	29	3	107	35.67
8	379	5941	15.68	31	1	1	1.00
9	309	5666	18.34	39	1	1	1.00
10	256	4614	18.02	43	1	127	127.00
11	200	5860	29.30	44	1	36	36.00
12	120	3240	27.00	48	1	92	92.00
13	76	2100	27.63	49	3	159	53.00
14	56	2236	39.93	51	2	146	73.00
15	30	1110	37.00	53	1	58	58.00
16	11	272	24.73	54	1	85	85.00
17	11	652	59.27	55	1	112	112.00
18	13	702	54.00	59	1	146	146.00
19	5	798	159.60	69	1	33	33.00
20	4	326	81.50	124	1	72	72.00
21	6	288	48.00	202	1	0	0.00
22	8	77	9.63	-	-	-	-

* Four papers that did not provide information on the names of authors were excluded from the analysis

4.6 Discussions of the findings

Generally, authorship of HIV/AIDS papers in and about E&S Africa is largely through multiple-authorship, or simply put, collaboration between two and/or more authors. This therefore implies that HIV/AIDS research in the region is conducted mainly through collaboration, although some of it is conducted individually. Despite the fact that single-author papers were visible and showed slight growth rates, Table 4.2 and Fig 4.1 indicate that they were fewer than the co-authored papers in each country throughout the period of study. The highest number of multiple authors was 202, a figure that could be said to be extra-ordinary. Assuming that all the authors indeed participated in the authorship of the said paper, the implication is that all the authors were involved in conducting a particular HIV/AIDS research project in or about E&S Africa. It would be interesting to investigate the management and organization of the study's research team and facilities, particularly if the project was a success, as this may provide some useful lessons in managing a large research team as this.

Table 4.3 confirms the dominance of co-author papers when we considered the average number of authors per paper, degree of collaboration and the collaborative coefficient. Whereas the average number of authors per paper was above two, implying a high pattern of collaboration, the multiple-author papers comprised 85.91% of the total number of papers (above 70% in each country), while the ratio of the collaborative papers to the total number of papers was 0.86 (cc was above 0.70 in each country).

Although the co-author papers were the majority, the visibility of single-author papers is in total disregard of Price's prediction in 1963 that single-author papers would disappear by 1980. Then, Price (as cited in Steynberg & Rossouw, 1995:469) predicted that "*if it [the rate of increase of co-authored papers] continues at the present rate, by 1980 the single-author paper will be extinct*". It was not immediately clear in this study why single-author papers are not only visible, but also increasing, albeit slowly, but it can be attributed to the type of research that is conducted in the region. As it were, basic research (which is commonly conducted in universities) may require little or no collaboration. On the other hand, applied/active research may require the participation of multiple researchers. Secondly, research on social or epidemiological aspects of HIV/AIDS can be equally conducted by a single individual as opposed to microbiological and virological issues of HIV infections.

Table 4.2 and Fig 4.1, further show that multiple-author papers have increased steadily since 1981. In fact, their increment can be said to be exponential. Several sociological studies of science that have been conducted to examine the nature of authorship as a means of studying research collaboration have registered similar findings, i.e. a continued increase in co-author papers (e.g. Basu & Aggarwal, 2001). The interest that has been placed on collaborative research, as opposed to individualistic research, stems from the benefits associated with collaboration. Seemingly, countries in E&S Africa have noted these benefits and are consequently encouraging researchers to embrace collaborative research. There were, however, several instances where countries with more papers had low percentage distributions of the total number of multiple-author papers. This scenario may be attributed to the high pattern of single-authorships in countries such as South Africa.

As regards sub-regional collaboration (collaboration between countries in Eastern and those of Southern Africa), a country's geographical location (e.g. proximity to another), seemingly plays a big role in influencing collaboration between countries in the two regions. For instance, with the exception of 14 papers which were co-authored between Kenya and South Africa, Kenya's major collaborating domestic partners were Tanzania (12) and Uganda (11). Both countries are located in Eastern Africa. South Africa also largely collaborates with Zimbabwe (20), Zambia (14) and Malawi (11). All three countries are part of the SADC region. Zambia, aside from her high collaboration with South Africa, collaborates largely with Kenya (11) and Zimbabwe (9). Similarly, Malawi's major collaborators include South Africa (12), Zimbabwe (6) and Zambia (4). It is difficult to predict the future trends of partnership between the countries in the two regions. On the one hand, the aforementioned pattern is likely to continue, especially in the case of Eastern Africa with the revival of the East African Community. On the other, Southern Africa (specifically, post-apartheid South Africa) is increasingly attracting the interest of researchers (and students) from other African countries, thus creating an environment for research collaborative activities between researchers in the region and those from outside the region. This may change collaborative patterns, especially in South Africa.

Collaboration between E&S African countries and the rest of Africa was minimal, although registering some visibility. Kenya, South Africa, Tanzania, Uganda, Zambia and Zimbabwe recorded a relatively high number of African countries with which each co-authored papers. These countries, all of which are located in central and western Africa, include Cote D'Ivoire, the Democratic Republic of Congo (Zaire), Benin, Nigeria, Gambia, Sierra Leone, Rwanda, Burkina Faso, and Ghana, with Cameroon maintaining a strong presence in all six countries with high patterns of collaboration. There was less activity in the co-authorship of HIV/AIDS papers between E&S African countries and northern African countries, which are largely Arabic speaking. Exceptions were as follows: Kenya and Egypt (3 papers); South Africa and Egypt (1 paper); South Africa and Tunisia (1 paper); Sudan and Egypt (6 papers); and Uganda and Egypt (3 papers). It should be noted that Sudan is largely Arabic while although English is a minority language. Evidently, therefore, E&S African countries largely collaborate with Central or Western African countries. This could be attributed to language and racial factors, although this claim may not be substantiated in this study.

Internal co-authorship (collaboration within the same country) was highest in South Africa (813 or 43.48%), followed by, in descending order of the percentage of the total number of papers in each country, Botswana (34 or 36.56%), Malawi (160 or 35.71%), Kenya (288 or 33.03%), and Ethiopia (83 or 32.55%). Notably, countries that were highly ranked in terms of their overall performance in research collaboration switched positions with those lesser ranked when it came to internal collaboration. For example, it was observed that Somalia was the highest ranked in terms of the collaboration coefficient (see Table 4.3), followed by Djibouti, Ethiopia, Angola, Tanzania, Kenya, Zimbabwe, Uganda, Zambia, and Malawi, while South Africa took position 11. The latter analysis (i.e. internal collaboration) reveals a heavy reliance of some countries such as South Africa, Malawi, and Ethiopia on publishing their research publications through internal partnerships. Kenya's minimal performance, when compared to Malawi in terms of internal collaboration, can be attributed to the latter's heavy reliance on international collaboration as illustrated in Table 4.7, which indicates that the country had the second highest number of foreign countries with which she collaborated. An analysis of the trend of internal collaboration between 1980 and 2005 shows a mixed pattern of growth. The last row in Table 4.5 reveals a remarkable increment of the number of internally co-authored papers from 0 papers in 1980-1982, to 443 in 2004-2005. These papers accounted for between 27.95% and 35.80% of the total multiple-author papers throughout the period of study, except for the 1983-1985 year period whose 6 papers accounted for 66.67%. Some countries recorded slightly higher percentages, the highest being 75.0%

from South Africa in 1983-1985, followed by Ethiopia which yielded 25 (62.5%) in 2004-2005. Overall, each country seems to be encouraging HIV/AIDS research collaboration among researchers resident in each respective country.

Table 4.7 illustrates that all the countries, except Namibia, had more foreign/international than domestic/regional country collaborators. This pattern concurs with what most writers have noted in previous studies, i.e. Less Developed Countries largely collaborate with Developed Countries (e.g. Narvaez-Berthelemot, Russell, Arvanitis, Waast, & Gaillard, 2001). In the case of Africa, previous studies (e.g. Narvaez-Berthelemot, Russell, Arvanitis, Waast, & Gaillard, 2001) have shown that countries in the continent publish most of their publications through international collaboration. In this study, a high pattern of collaboration was witnessed between E&S African countries and several industrialized nations, with the USA, England and the Netherlands being the major collaboraters. Narvaez-Berthelemot, Russell, Arvanitis, Waast, & Gaillard (2001:474) attribute this pattern to the dependence of developing countries on industrialized countries for the publication of their papers. The authors opine that "*the less productive the developing country, the greater the dependence on international co-authorship for mainstream publication*". In addition, they observe that international collaboration is influenced by the countries' historical ties, especially as regards colonial legacies. Commenting on their findings, the authors argue that "*the colonial legacies of many of the African countries*" was one of the factors that influenced scientific ties with industrialized countries such as France and the United Kingdom. Similar patterns were found in the present study, especially in the 1980s. For instance, England dominated the scene in E&S African international co-authorships in the 1980s. This gradually changed with the emergence of the USA in the early 1990s, which has maintained a strong presence in most countries in the region. The country co-authored HIV/AIDS papers with 16 out of 18 countries in E&S Africa. The highest posting was recorded with South Africa (352) followed by Uganda (284), Kenya (280), Tanzania (154), Malawi (138) and Zimbabwe (87). This is despite the country's late entry into the collaborative network in the region. It was observed that England, Switzerland and Netherlands were among the first countries to collaborate with countries from the E&S African region. E&S African countries' strong collaborative links with the USA since the early 1990s may be attributed to the latter's funding of HIV/AIDS research in the region. The USA has become one of the major funders of HIV/AIDS intervention programs in E&S Africa.

An exposition of the inter-institutional partnerships demonstrates that collaboration was largely between institutions in E&S Africa and foreign-based institutions, as was the case in country-wise collaboration. Collaboration among institutions in Africa was minimal, although with some visibility, especially in South Africa. Table 4.8 illustrates that the highest pattern of domestic/regional collaboration involved the University of Makerere and the Uganda Virus Research Institute (95), while the University of Witwatersrand and the South African Institute for Medical Research co-authored 83 papers. Another notable HIV/AIDS research collaboration between two local institutions involved the University of Natal (now the University of KwaZulu Natal) and South Africa's Medical Research Council, which yielded 88 papers. Generally, South Africa recorded the largest local collaborative network, which was largely between and among the Universities, hospitals and Government laboratories. This pattern may be attributed to South Africa's isolation from the global scientific arena during the apartheid era, research policies, and established local research centers and structures, etc. Institutions in the other countries of E&S Africa exhibited strong collaborative links largely with institutions from outside Africa, and more particularly with those based in the USA. This could be influenced by the factors that were given concerning country-wise collaboration.

Table 4.8 also indicates that institutional collaboration was largely between universities and/or other academic-based institutions (e.g. teaching hospitals). Therefore, HIV/AIDS research in E&S Africa is mainly conducted through collaboration between researchers in universities. Universities are thought to be staffed with the most qualified researchers in a country. Furthermore, most researchers in a given country (at the very least) went through university education and any research activities that they may have conducted while pursuing their education might have been registered under the name of their respective university. It has been observed that these student researchers usually publish their research in conjunction with their promoters (Ocholla, 2000; Onyancha, 2006).

Perhaps this factor may have influenced the high pattern of collaboration among universities. It was also encouraging to note partnerships between universities and government laboratories (including teaching hospitals), which are sometimes classified under industry. The highest pattern involved the Fred Hutchinson Cancer Research Center and the University of Washington, a partnership that contributed 189 papers. Other government laboratories or research centers that had research partnerships with universities include the Medical Research Council (South Africa), which co-authored 53 papers with the University of Natal (now University of KwaZulu Natal) and 31 papers with the University of Cape Town. Other collaborations involved NIAID and Makerere University (44), the Kenya Government Medical Research Center and the University of Nairobi (44) and the University of Alabama and the Tropical Diseases Research Center (33). University-industry cooperation is increasingly being encouraged by most governments because of the benefits associated with such types of collaboration. It is well acknowledged that most universities in Africa, although rich in human resources, are lacking in financial resources that could enable them to conduct meaningful and effective research. Hence, partnering with the industry would lessen their financial strains while maximizing their skills as researchers.

With regard to collaboration between individual authors, it was observed that there has been a continued growth in the number of collaborative networks. The networks grew from just two in 1981-1985, to a total of 18 in 2001-2005, accounting for a growth rate of about 800%. Obviously there were more networks than these. The networks that are presented in Figures 4.6 to 4.10 are only those that met the threshold requirements. This growth pattern of collaborative networks could be attributed to several reasons, chief among them, the complexity as well as cost of HIV/AIDS research. These, compounded by the lack of a cure for the disease, could have led researchers to seek alliances. Other factors that influence collaboration amongst researchers include personal factors (e.g. trust, expertise, social networks, personal compatibility, common professional traits); resource-related factors (e.g. support from funding agencies, support from scientists' institutions, literature, scientific publishing, students, time); motivational factors (e.g. learning and teaching, new discoveries, fun, external rewards); and "common ground" factors (e.g. physical proximity, research organizations, disciplinary bias, discipline-specific languages, bridges), etc (Maglaughlin & Sonnenwald, 2005:507).

Figures 4.6 to 4.10 also indicate that several collaborative networks have recently emerged, while several others that previously existed have disappeared, or are on the verge of disappearing, from the most active author networks. It would be interesting to investigate the factors that cause or might have caused such patterns. Most probably, this phenomenon could be caused by the completion of a project(s), which would mean that researchers do not have any reason for continued cooperation, unless they register another project. Although very rare, the non-completion of a project due to factors such as the misappropriation of research funds, mistrust, dissatisfaction on the part of some researchers, etc., may cause the break up of a collaborative network. Sometimes, author networks can be dissolved when their participants form new alliances, become incapacitated or die. Finally, donor funding may dictate the type of researchers who should be incorporated into a network. These factors, and many others, also may have influenced the movement of some researchers from one network to another. None of these factors could, however, be confirmed from the analyses in Fig 4.6 – 4.10. Caution should be taken when making such generalized observations given that the networks in Fig 4.6-4.10 were only those that met the threshold requirements. Some of the authors may have continued to participate in their respective author networks, but perhaps did not meet the set thresholds and therefore did not feature in the illustrations. It could not, therefore, be concluded that certain researchers had totally disappeared. They may have become less active.

4.7 Summary

The purpose of this Chapter was to examine the nature, types and trends of HIV/AIDS research collaboration in E&S Africa between 1980 and 2005. Among its objectives, the Chapter sought to: study the trend of single and multiple-author papers between 1980 and 2005 in order to determine the trend of collaboration; examine the type of collaboration in HIV/AIDS research, i.e. internal, sub-regional and international country collaboration, and inter-institution collaboration, etc.; reveal the collaborating authors, institutions, and countries in the two regions, with the intent to propose strategies of strengthening such collaboration; assess the degree and extent of HIV/AIDS research collaboration in E&S Africa; and to identify the most active collaborative networks in E&S Africa and find out the geographic areas of research focus of the author collaboration networks. Only data that was downloaded from ISI's databases were analyzed in this Chapter.

Using co-authorship of papers as an indicator of research collaboration, data was analyzed and presented in order to: measure the extent of research collaboration by calculating the mean number of authors per co-authored paper, the degree of collaboration, and the collaboration coefficient; and to identify collaborating institutions, countries, and authors. A trend analysis of author collaboration networks was conducted in order to check for growth and the development of the networks as well as shifts in partnerships among the authors/researchers.

The results reveal that there has been a continued growth of multiple-author papers, suggesting that research in E&S Africa is increasingly being conducted through collaboration between two and/or more researchers. Foreign countries, especially industrialized nations, were the main collaborators with E&S African countries, led by the USA, England, and the Netherlands. Internal/domestic, sub-regional and regional country-wise collaboration was minimal, a situation that may be attributed to the desire of less developed countries' to publish their papers through international collaboration. South Africa recorded the highest number of internally co-authored papers, in contrast to most of the other countries whose highest number consisted of foreign collaborating countries. South Africa's case may be attributed to the country's isolation during the apartheid era, and the existence of well established local research centers and structures. Other reasons that appear to be playing a role in country collaboration are language and geographic proximity. Eastern African countries tended to collaborate more with other countries in the region, and Southern African countries did likewise. This trend is likely to continue with the revival of the East African Community.

Institutional collaboration was largely based in universities. Major collaborators included the University of Nairobi, University of Washington, University of Manitoba, Makerere University, Harvard University, Johns Hopkins University, Fred Hutchinson Cancer Research Center, Case Western Reserve University, etc. Collaboration between universities and other teaching/academic-based institutions such as teaching hospitals and government laboratories (e.g. government-owned medical research institutes/councils) was noted. Again, institution-wise collaboration reflected the pattern found when analyzing country-wise collaboration, i.e. foreign based institutions were the main collaborators with those based in E&S Africa.

The author collaboration networks revealed three major findings, notably:

1. the continued growth of collaboration networks
2. the disappearance of some networks and emergence of new ones
3. a few instances of shifts of author alliances

Finally, an analysis of the influence of research collaboration on research impact revealed that whereas single author papers increased the average impact by 3.48 citations, multiple author papers increased the average impact by 12.75 citations, a situation that may strongly advocate the promotion and strengthening of research collaboration networks in the region.

The next Chapter deals with the sources that publish HIV/AIDS research conducted in and about E&S Africa.

CHAPTER FIVE

SOURCES OF EASTERN AND SOUTHERN AFRICAN HIV/AIDS LITERATURE

5.1 Introduction

Upon launching the global media initiative in the fight against HIV/AIDS, the United Nations Secretary-General, Kofi Annan, observed that "*when you are working to combat a disastrous and growing emergency, you should use every tool at your disposal*" (Kaiser Family Foundation, 2005). As channels of communicating HIV/AIDS information, serials in general, and journals in particular, are increasingly becoming effective and reliable tools against the disease. These sources, among others, have tremendous reach and influence, and thus provide a means to, as well as could play a significant role towards, a successful campaign against the pandemic. Scientific journals also play a vital role in the dissemination of research results through publications, whose importance in advancing the careers of scientists increases the chances of these journals influencing research priorities (Momen, 2004). Garfield (1973) observes that journals form part of the communication network and play an important role in the exchange of scientific and technical information. How journals and other sources of information generate and disseminate scholarly knowledge in a discipline is very important, not only to researchers, but also to information providers. It is therefore fundamentally important that proper selection and management of these sources is carried out.

Since the first case of HIV/AIDS was clinically diagnosed in the United States, the amount of research, and by extension, the growth in literature on the subject, is said to have proliferated (Pratt, 1992). Pratt (1992:381) found a tremendous increase in the number of journals publishing HIV/AIDS research from "*17 in 1982 to 217 in 1983, a 13-fold increase*". An additional 200 to 350 journals indexed in the MEDLINE database published at least an article each for the first time between 1983 and 1990. The period between 1987 and 1990 witnessed an average of 1,100 journals in the MEDLINE database publishing at least one article each on AIDS.

Consequently, this information explosion has changed the face and function of libraries, particularly biomedical libraries, introducing numerous challenges. The recent rapid increase in the number of journals publishing AIDS papers has left librarians and other information providers in a dilemma. In addition to the many inherent problems facing libraries in developing countries, such as lack of physical infrastructure and space, the budgetary allocation for the purchase of resources has continued to 'grow thin'. The cost of journal subscription has significantly increased in the last few years, further complicating matters for libraries and librarians. In the words of Grant (1994):

> "*The spiraling cost of journal subscriptions and the proliferation of biomedical information have combined to place additional pressure on biomedical libraries to meet the needs of their users. The information explosion is forcing libraries everywhere to become dynamic access points, which lead to a wide range of information sources. In some libraries, lending of books and journals from in house collections has become secondary to 1) the locating and accessing of information stored electronically in local and remote sites; 2) the delivery of the identified information, through photocopies, fax, etc*" (Grant, 1994: Information explosion section).

Researchers have not been spared either. Although it may seem as though they have a variety of sources in which to publish their research findings, confusion reigns when deciding on the right journal in which to publish, viz. a journal that can give them broader visibility and influence. Due to the financial constraints that face libraries, librarians have been urged to meticulously choose resources that satisfy the ever increasing and dynamic patron's needs at minimum cost. Davis (2002) recommends that "*librarians need to be discriminating selectors*", spending their minimal financial resources on "*titles that are considered core to the collection*". One may ask, why be selective and not all-inclusive? According to ISI (2004: para 2), selecting all the journals in a particular discipline would not only be "*impractical economically, but as analyses of the scientific literature have* *shown, unnecessary*" because it has been "*demonstrated that a relatively small number of journals publish the bulk of significant scientific results*".

The purpose of this Chapter is two-fold, i.e.:

1. to examine the growth, productivity and scientific impact of HIV/AIDS sources of information [source publications] as they relate to E&S Africa between 1980 and 2005 in order to assess the visibility and coverage of HIV/AIDS sources in three key bibliographic databases
2. to provide relevant information which may assist information providers, users in general, and more specifically, collection development librarians, particularly in the two regions, in their decision making processes regarding the identification, selection and development of relevant HIV/AIDS resources

This chapter hence focuses on the following pertinent sub-questions:

- How many sources (i.e. serials) are published in Africa, and how are they covered in each of the three databases (i.e. MEDLINE, SCI, & SSCI)?
- What source types publish HIV/AIDS papers/articles about E&S Africa?
- What is the growth rate of sources which publish HIV/AIDS literature about E&S Africa?
- Which geographic regions publish HIV/AIDS sources that carry HIV/AIDS research that is conducted in and about E&S Africa?
- How many sources publish HIV/AIDS research in and about E&S Africa and which of these are the most productive source(s)?
- What is each HIV/AIDS source's influence (i.e. scientific impact)?
- Which are the most commonly used sources by researchers to conduct HIV/AIDS research in and about E&S Africa?
- In which subject category do the sources that publish HIV/AIDS research belong?
- Which are the core sources of HIV/AIDS information on E&S Africa?

5.2 Evaluating source publications: an overview

There are as many reasons for evaluating information resources as there are many and varied groups of people interested in information production, storage, dissemination, and use. Researchers and other information users are often advised to evaluate resources as not all 'information' is authoritative, objective, valid, reliable, timely, or comprehensive (Kentucky Virtual Library, 2004a; 2004b). Primarily, sources of information are evaluated for content and scope. In measuring scope, resources are evaluated for breadth and depth, in addition to purpose, audience, accuracy, authority, currency, and quality when assessing content. A number of studies conducted to analyze the production, distribution and influence of periodicals in general, and journals in particular, show the importance of conducting journal evaluation processes. Pratt (1992) argues that an analysis of the number of periodicals publishing HIV/AIDS literature may be used to measure the disease's impact, and Macias-Chapula (1990:218) argues that in order for Less Developed Countries (LDCs) "*to plan the allocation of resources for the development of their scientific programs*", they "*need to be aware of their scientific production and contribution*". Tague, Beheshti & Rees-Potter (1981) suggest that the growth in the number of publications (which can be in the form of articles or sources publishing those papers) can be used as an indicator of the growth of knowledge. They observe that in bibliometrics, "*growth in number of publications is sometimes taken as a measure or operational definition of growth of knowledge*" (Tague, Beheshti & Rees-Potter, 1981:126). Similarly, they argue that "*knowledge growth may mean literature growth – increase in the number of publications in a field – or information growth – increase in the number of ideas in the field*" assuming that "*all knowledge is contained in the published literature, and second, that every paper contains an equal amount of knowledge*" (Tague, Beheshti & Rees-Potter, 1981:130).

Librarians, documentalists, and electronic database publishers are particularly interested in evaluating sources in order to enable collection management (Rousseau, 2002; ISI, 2002). Whereas documentalists and librarians sometimes select and deselect their journals on the basis of the availability or lack of funds and/or recommendations from the faculty (in the case of university librarians), database publishers frequently manage their collections on the basis of the journals' influence. In the case of researchers, he/she would evaluate resources in order to find out the most qualitative source in which he/she could publish his/her research findings aside from retrieving quality information relevant to his/her further research activities (Rousseau, 2002). Rousseau (2002:419) (citing several authors such as Van Hooydonk, et al.; Van Hooydonk; Pao & Goffman; Lewison & Dawson) outlines other purposes for which specific groups of people/institutions would conduct journal evaluations as follows:

- Funding agencies and governments would wish their grantees to publish in the most prestigious journals
- Editors and publishers may relate high citation scores to a successful editorial practice and policy
- Commercial publishers are interested in subscription data and sales
- Information brokers are interested in finding sources that can most satisfy their clients' needs
- University research councils use journal impact and prestige scores as elements in local research evaluation studies in view of enlarging the visibility of the university's research

Just as there are many purposes for which journals and other sources of information are evaluated, there are equally many approaches/techniques/methods proposed to conduct such assessments. Both non-bibliometric and bibliometric indicators may be used to judge the quality and/or influence of source publications. Non-bibliometric indicators, opines Sen (1999, non-bibliometric indicators section, para 1), are "*based on data which are not available or can not be derived from the document description or the documents*". Some of these indicators, which can be used to evaluate sources, include the circulation statistics of these sources and the prestige of the publishing company. In other words, the library use of the sources and the publishing company's reputability can yield valuable data which can then be used to evaluate the quality and impact of sources. Circulation statistics would normally reveal the amount of use made of a library's holdings. Circulation statistics include checkout and fine statistics, in-library usage by material, in-library usage by material type, number of patrons making use of the library resources.

usage by patron type, and usage totals from the circulation log, etc. Of particular relevance in the evaluation of resources, and more so, journals, is the library usage (both in-library and checkouts) of resources. It is believed or assumed that whenever one borrows a library resource, he/she will make use of it. Similarly, a book that was on the shelf but later found lying on the reading tables will be said to have been used. Although this is not always the case, there is a general consensus that both in-library usage and checkout statistics may yield valuable information which can assist in evaluating the quality of resources. Generally, obtaining library statistics has been made easy by library automation software such as Winnebago Spectrum. The publisher's reputation, and that of the editor(s), argues Rousseau (2002), is a good indicator of a journal's importance or quality, especially in the case of new journals. New journals published by reputable publishers (e.g. Elsevier), are likely to attract quality authors,, hence improving their quality status. The number of databases indexing a given journal can also act as an indicator of a journal's importance or quality. However, as Rousseau (2002) opines, it is worth noting that although a journal's mere coverage in an indexing database is not enough, it matters whether the database is the most important in the subject field or not. Rousseau (2002) therefore suggests that if a journal is indexed in high quality databases, it is likely to be of high quality. Examples of the kind of databases Rousseau had in mind are the ISI's citation indexes, which cover high impact journals only. Other quality evaluation processes take into consideration the number of subscriptions, the amount of corresponding revenues (in the case of popular science journals such as *Scientific American*, *Science*, and *The New Scientist*), and the number of interlibrary loan requests. In the instance of interlibrary lending, Rousseau (2002:421) argues that the number of local ILL requests for a journal "*can act as an indicator of its importance for the community served by the library*". Finally, peer-review (although it sometimes makes use of bibliometric indicators) is another non-bibliometric approach used to evaluate sources. In peer review, published sources are scrutinized by experts in the field and given scores for quality and quantity according to established rules. The panels of subject experts act as "*judges to determine the value of journals and ... to draw formal ranked lists*" (Rousseau, 2002:421). This is particularly relevant at national or local level, where investigations on local or national journals/sources are prominently conducted to determine their worth. The weaknesses associated with peer-review are outlined in detail in Chapter Six.

Bibliometric indicators, according to Sen (1999), are defined as measures, indices or statistics (preferably objective) of the impact or quantity of publications as documentary products, and can be classified into direct, derived, assigned or mixed indicators. In their simplest application to the evaluation of sources, bibliometric indicators can be used to examine elements or characteristics such as standards for the acceptance of manuscripts, how representative the editorial board is, the refereeing system, promptness of publication, the journal's coverage in major abstracting and indexing services, the confidence level of scientists publishing in a given journal, the frequency of citation by other journals, a journal's inclusion of abstracts or summaries in English, and the provision of authors' addresses and complete bibliographic information (Zwener, Garfield, and Testa as cited in Rousseau, 2002). A number of informetric indicators have been developed in order to evaluate the quality of journals. These indicators generate very useful data that is applicable when characterizing and ranking journals and other sources of published literature. They include: the *attraction power of a journal* (the portion of articles that the journal publishes by authors outside the country, language, or organization usually associated with the journal); *the consumption factor* (a combination of two characteristics of journal citations, i.e. the citation factor and the popularity factor); the *importance index* (a measure of the relative importance of a journal in a group of journals in a given subject area, calculated as "*the number of citations from journal A to journal B*" divided by "*the number of citations from journal A to all documents whether or not they are in the group being analyzed*"); the *influence weight* (a measure of the relative influence of one journal on a group of journals in a given subject area, calculated as "*the number of citations from journal A to journal B*" divided by "*the number of citations from journal B to all the journals in the group being analyzed*") and the *mean response rate* (a measure of citation speed – i.e. the rate at which articles in a journal are used and cited). Others include: *journal standing* (a measure of the relative importance or influence of one journal among a group of journals in a given subject, calculated as "*the number of citations from journal A to journal B*" divided by "*the* *number of citations to journal B from all the journals in the group being analyzed plus the number of citations from journal B to all the journals in the group being analyzed*"); the *popularity factor* (e.g. the number of journals that cite articles in journal A divided by the number of journals that journal A's own articles cite); and the *impact factor* (measure of the frequency with which an 'average article' in a journal has been cited in a particular year) (Diodato, 1994; Garfield in Pao & Goffman, 1990:230).

Of all the citation-based measures, impact factors are perhaps the most extensively used bibliometric indicators in ranking and evaluating journals. As set out by Garfield & Sher (as cited in Rousseau, 2002), the impact factor is the ratio between citations and recent (previous two years) citable items published. Citable items include articles, reviews, letters, discovery accounts, notes and abstracts. Popescu (2000) defines the impact factor as the "*average number of citations in a given year of articles published in a journal in the preceding two years*". According to the standard *Garfield impact factor calculation*, the ratio is obtained from dividing citations received in one year by papers published in the two previous years (Garfield, 1996:411). The standard *Garfield impact factor* can be expressed as follows (Rousseau, 2002):

$$\frac{\text{CIT (2002, 2001)} + \text{CIT (2002, 2000)}}{\text{PUB (2001)} + \text{PUB (2000)}}$$

Where:

CIT (2002, 2001) = 2002 cites to articles published in 2001

CIT (2002, 2000) = 2002 cites to articles published in 2000

PUB (2001) = Number of articles published in 2001

PUB (2000) = Number of articles published in 2000

The use of citations and impact in characterizing and ranking journals has featured prominently since 1976 (Popescu, 2000; Rousseau, 2002), when the Journal Citation Reports (JCR) were first published by the Institute of Scientific Information (ISI) – now known as ISI – under the directorship of Eugene Garfield. The phrase, coined by Garfield and Sher in the early sixties, was initially used as "*a simple means of comparing journals* *regardless of size*" (Garfield, 1998:768). Currently, impact factors are sometimes used as 'surrogates in evaluation exercises'. They have become useful tools when ranking, evaluating, categorizing and comparing journals, especially those in the same subject field or discipline. The impact factor has increasingly become a crucial indicator of journal quality and importance (Krichel, 2002). To librarians, they are tools for collection management, while publishers view impact factors as quantitative evidence when evaluating the position of their journals. Quite recently, impact factors have been used to measure individual performance. They have been used to identify hot papers, influential scientists, the most active laboratories, institutions, research fronts, and most productive countries. World science mapping and policy is another area in which impact factors have been utilized. The latest development is the use of impact factors in academic evaluations for the purposes of academic promotion and the evaluation of individual academic programs.

However, even with their wide inception, impact factors have been faulted on some grounds. Whereas some scholars have encouraged the use of impact factors (e.g. Stegmann, 1999), many are of the view that they should not be used to evaluate research (e.g. Seglen, 1997). Seglen enumerates several shortcomings associated with the use of impact factors as a means of evaluating performance, and more particularly, as indicators of journal quality. Generally, these problems are associated with the relationship between the journal impact factors and citation rate of articles; impact factor calculation; and the indexing database's limitations (Seglen, 1997).

The proponents (Eugene Garfield among them) of impact factors have, however, strongly defended the use of impact factors in evaluating research. Nisonger (2004) argues that if impact factors are used appropriately and in combination with other criteria, they become valid tools that assist with journal collection management decisions in research libraries. Egghe & Rousseau (1990:255) feel that the impact factor is a better measure of the scientific importance of a journal than the total number of citations because it takes into account the total number of publications.

Journal evaluation studies date as far back as 1920 (ISI, 2004a; Garfield, 1972), when Gross & Gross analyzed citation patterns in chemical education. The authors, who set out to determine which chemistry periodicals best served a small college library (Gooden, 2001), produced a list of scientific periodicals in chemical education, ranked according to the level of citedness. In 1934, Bradford conducted a bibliography study on geophysics and subsequently formulated what came to be known as Bradford's Law of scattering, or Bradford's Law of Dispersion. Since then, many studies have been conducted that evaluate journals in various subject disciplines.

For instance, Rao (1990) conducted a study that analyzed journal productivity in economics by studying the distribution patterns of articles and rank distribution of economics journals. Among other conclusions, he observed that *"the empirical distribution of articles is reverse-J shaped with a long tail and distribution is highly positively skewed.. [and] that 99% of the journals contain 90% of the articles [and] that only one percent of the journals contribute nearly 10% of the periodical literature in economics"* (Rao, 1990:251). Rao (1990) concluded that the 80-20 rule was not applicable to economics journals.

On the topic of HIV/AIDS, the ranking and identification of sources of HIV/AIDS papers in and about some geographic regions such as Haiti and Central Africa has been reported in bibliometric studies (e.g. Macias-Chapula, 2000; Macias-Chapula & Mijangos-Nolasco, 2002). For example, in ranking sources according to the number of articles each yielded on HIV/AIDS in Central Africa, Macias-Chapula and Mijangos-Nolasco (2002) found that *AIDS* (68) was leading, followed by *Med Trop* (Marseille) - *Médecine tropicale : revue du Corps de santé colonial* – (34), *Lancet* (31), *AIDS Res Human Retroviruses* (29), and *Bull Soc Pathol Exot* (20).

In the Haiti study, Macias-Chapula (2000) noted that most articles were published in periodicals, which contributed 84.29% of the total number of papers. The author further found that the *International Conference of AIDS* was the leading publication, with 110 postings, while the *New England Journal of Medicine*, *Journal of the American Medical*

Association, *Analysis of Inetrnal Medicine*, *Lancet* and the *Annals of the New York Academy of Science* contributed 19, 15, 14 and 12 articles, respectively. Thus, the *International Conference of AIDS* alone became the core source of AIDS literature on Haiti. A critical analysis of Haiti's sources indicates that most are general medical journals. Similar observations were made by Pratt (1992) who, upon excluding journals devoted entirely to AIDS, found that leading medical journals that published HIV/AIDS papers included the *Lancet*, *JAMA*, and *Nature*. The *Lancet* produced the majority (i.e. 1054), while *JAMA* - the journal of the American Medical Association - and *Nature* produced 728 and 587 articles, respectively.

By 1992, the pattern had changed: general medical journals were no longer the leading proponents of AIDS literature. Instead, AIDS-specific journals dominated the scene. The Journal of Virology which was nowhere (so to speak) in 1989, came first in 1992 (Bierbaum & Brooks, 1995). This change has been attributed to the increased specialization of AIDS publications (Macias-Chapula, Rodeo-Castro, Nervaez-Berthelemot, 1998). The leading specialty journals by 1992 included the *Journal of Virology*, *AIDS (Acquired Immune Deficiency Syndrome)*, *Journal of Acquired Immune Deficiency Syndrome*, *AIDS Research and Human Retroviruses, and International Journal of STD & AIDS*. Similar observations have been made by Onyancha & Ocholla (2005). Apart from the *Journal of Adolescent Health*, the five top journals are AIDS-specific. In descending order, they are *Int Conf AIDS* (1008 or 34.7%), *AIDS Education and Prevention* (82 or 2.82%), *AIDS* (62, 2.13%) and *International Journal of STD and AIDS* (44, 1.52%). Other specialized sources, according to Onyancha & Ocholla (2005), include *AIDS Care*, which came 7th with 43 (1.48%) articles, *Journal of Acquired Immune Deficiency Syndromes* (31, 1.07%), *Natl Conf Women HIV* (27, 0.93%), *AIDS Patient Care and S T Ds* (25, 0.86%), and HIV *Infect Women Conf* (20, 0.69) articles.

Of particular interest, is that in all the aforementioned studies, the *Int Conf AIDS* publication consistently featured as the most commonly used source for publishing HIV/AIDS research. In their study "*a comparative study of the literature on HIV/AIDS in*

Kenya and Uganda: a bibliometric study", Onyancha & Ocholla (2004b) recorded similar findings.

Journals have also been ranked according to the countries of publication. Major contributing geographical regions have been found to be developed countries. In Onyancha & Ocholla's (2004a) study, Switzerland led with 276 publications, Canada yielded 244, while Japan and the Netherlands produced 111 and 122 records, respectively. Germany, the United States and Italy were ranked fifth, sixth and seventh with 121, 87, and 39 records, respectively. Kenya (5), South Africa (2) and Uganda (7) were the only African countries that published AIDS literature on Kenya and Uganda. Africa's limited contribution in many informetric studies may be attributed to the databases used to collect data. The most commonly used databases are MEDLINE, Science Citation Index, Social Sciences Citation Index and the Science Indicators. All these key bibliographic databases are published in the USA.

5.3 Methods and procedures

The approaches that were used to collect data in order to evaluate source publications are set out in Chapter Five. Summarily data was downloaded by year of publication, using search terms in both Tables 3.2 and 3.3. Once downloaded, the data was saved in *.txt* file format. This was so that the files containing the downloaded data could be compatible with the bibliographic management software used to analyze the data. The software included Bibexcel, Stikis, and Citespace. Data was then analyzed as follows:

- By database in order to measure the coverage of HIV/AIDS sources in the databases
- By document type in order to determine the most preferred type of source in publishing HIV/AIDS information on E&S Africa
- By the year of publication of the sources in order to examine the sources' growth trends
- By the places of publication - to aid in determining the geographic distribution and dissemination of the sources and research findings, respectively

- By the total number of publications in each source in order to identify the most commonly used source(s) to publish HIV/AIDS research about E&S Africa
- The citation impact, derived from the Journal Citation Reports of ISI (henceforth known as ISI – Institute for Scientific Information), was used to examine the sources' influence
- By the number of citations - to measure the sources' productivity in terms of the number of citations received as well as to identify the most commonly used sources by researchers in conducting HIV/AIDS research
- By subject category in order to determine the subjects/disciplines that utilize HIV/AIDS research and the scatter of HIV/AIDS research in various disciplinary sources

Additionally, we examined and identified serials published in E&S Africa, the objective being to determine their coverage in the two indexing services (i.e. National Institute of Health responsible for the publication of MEDLINE and the ISI). A Bradford analysis was conducted in order to find out the core sources of HIV/AIDS information using both the number of papers, and citations.

Two periodical lists were used to collect additional information on the source publications, i.e. data that was not readily available in the databases, e.g. places of publication, number of sources published in E&S Africa and subjects/disciplines that each source publication dealt with. The Ulrich's Periodicals Directory™ - ©2004 -, produced by R.R. Bowker, is a comprehensive and continuously updated source of information on over 271,000 periodicals and serials from 80,000 publishers in over 200 countries. It includes annuals, continuations, conference proceedings, academic/scholarly publications, trade publications, consumer magazines, newsletters and bulletins. The Directory provides each publication's title, status, and name of publisher, address and telephone numbers, editor, year of first publication, ISSN, Dewey Decimal and Library of Congress classification numbers, and the British Library Shelf Mark. ISI's complete list of journals was used to provide required information that was not available in Ulrich's Periodicals Directory. ISI's list provides the title, frequency, ISSN, publisher, and the place of publication of journals indexed in ISI's main databases, i.e. the Arts and Humanities Index, Science Citation Index and Social Sciences Index.

Finally, the citation impact factor and immediacy index for 2002 were obtained from the *ISI's Journal Citation Reports (JCR) of 2004*. The JCR is a unique resource for journal comparison and evaluation, using citation data from over 7,000 scholarly and technical journals worldwide. Coverage is multidisciplinary and international, and incorporates journals from over 3,000 publishers in 60 nations.

5.4 Presentation of the Findings

Results are presented under 11 subheadings as follows:

1. Production of source publications in E&S Africa
2. Coverage of journals published in Africa in MEDLINE, SCI and SSCI
3. Distribution of HIV/AIDS sources by database
4. Distribution of HIV/AIDS records by document type
5. Growth and distribution of HIV/AIDS sources, 1980-2005
6. Average number of records per source publication
7. Geographic distribution of source publications
8. Productivity of source publications
9. Journal influence
10. Distribution of sources by subject category
11. Core sources of HIV/AIDS research in E&S Africa

5.4.1 Production of source publications in E&S Africa as at 2006

According to the information gathered from the online version of R. R. Bowker's Urlich's Periodical Directory, E&S African countries published a total of 1393 periodicals as at April 2006 (see Table 5.1). South Africa led with a total of 916 periodicals, followed by Kenya (113), Zimbabwe (78), Tanzania (48), Malawi (40), Ethiopia (36), Zambia (35), and Uganda (30). The results reveal that no sources were published in Somalia, while Djibouti and Eritrea, each with one periodical, did not produce any scholarly source publication.

Table 5.1: Number of sources published in E&S Africa, 2006

No.	*Rank*	*Country*	*Academic/ Scholarly*	*Newspaper*	*Newsletter/ Bulletin*	*Consumer*	*Trade/Business-to-Business*	*TOTAL*
1	1	South Africa	354	96	156	163	224	916
2	2	Kenya	50	15	36	16	9	113
3	3	Zimbabwe	33	14	10	16	22	78
4	4	Tanzania	31	7	9	3	4	48
5	5	Malawi	13	14	10	10	5	40
6	6	Ethiopia	13	6	16	7	1	36
7	7	Zambia	12	10	9	7	2	35
8	8	Uganda	10	15	3	11	0	30
9	9	Botswana	9	6	9	4	1	27
10	10	Namibia	9	10	2	8	2	24
11	11	Lesotho	3	6	3	3	0	13
12	12	Swaziland	3	3	3	4	0	10
13	13	Mozambique	1	1	6	3	0	9
14	14	Sudan	4	0	3	0	1	7
15	15	Angola	1	1	2	2	0	5
16	16	Djibouti	0	1	0	0	0	1
17	16	Eritrea	0	0	1	0	0	1
18	17	Somalia	0	0	0	0	0	0
		TOTAL	**546**	**205**	**278**	**257**	**271**	**1393**

Classifying the sources into different categories produced the following pattern, in descending order: academic/scholarly (546), newsletter/bulletin (278), trade/business-to-business (271), consumer (257), and newspaper (205). Comparatively, the United Kingdom produced a total of 15773 periodicals, constituting 6646 academic/scholarly, 572 newspaper, 2134 newsletter/bulletin, 2876 consumer, and 4561 trade periodicals. The United States surpassed this with 52604 periodicals, comprising 13671 academic/scholarly, 9856 newspaper, 12375 newsletter/bulletin, 9131 consumer, and 13353 trade periodicals. Note that the totals in column 9 are not the sum of the figures in columns 4 to 8 since some periodicals could belong to more than one category.

5.4.2 Coverage of journals published in Africa in MEDLINE, SCI and SSCI

An examination of the MEDLINE periodical list and ISI's Master list produced the results presented in Table 5.2.

Table 5.2: Current Coverage of Journals Published in Africa in the Medline, SCI and SSCI databases as at February 2006

	MEDLINE (N=4844)	*SCI (N=6474)*	*SSCI (N=1847)*
South Africa	9 (0.186%)	19 (0.293%)	4 (0.217%)
Egypt	**4 (0.083%)**	**1 (0.015%)**	**0 (0.000%)**
Nigeria	5 (0.103%)	0 (0.000%)	0 (0.000%)
Kenya	**2 (0.041%)**	**2 (0.031%)**	**0 (0.000%)**
Tunisia	2 (0.041%)	0 (0.000%)	0 (0.000%)
Algeria	**1 (0.021%)**	**0 (0.000%)**	**0 (0.000%)**
Ethiopia	1 (0.021%)	2 (0.031%)	0 (0.000%)
Madagascar	**1 (0.021%)**	**0 (0.000%)**	**0 (0.000%)**
Uganda	1 (0.021%)	0 (0.000%)	0 (0.000%)
Zimbabwe	**1 (0.021%)**	**0 (0.000%)**	**0 (0.000%)**
TOTAL	**27 (0.557%)**	**24 (0.370%)**	**4 (0.217%)**

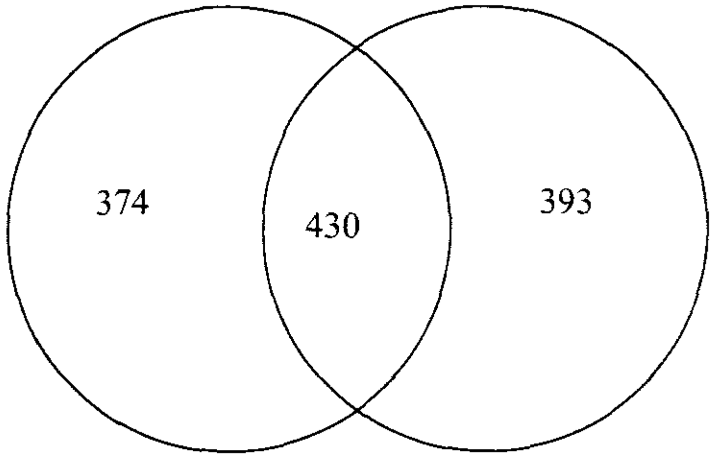
Note: the percentages are calculated as ratios of the total number of sources indexed in each database

The MEDLINE database indexed 27 source publications which accounted for 0.557%. As the table indicates, South Africa led with 9 (0.186%), followed by Nigeria (5 or 0.103%), Egypt (4 or 0.083) and Kenya and Tunisia which produced 2 (0.041%) publications each. The thesaurus indexed 1 (0.021%) publication each from Algeria, Ethiopia, Madagascar, Uganda and Zimbabwe. ISI's SCI and SSCI indexed a total of 28 journals which consisted of South Africa's 23, Kenya's 2, Ethiopia's 2, and Egypt's one journal(s).

5.4.3 Distribution of HIV/AIDS Sources by Database

There were 804 Medline-indexed sources and 823 ISI-indexed journals that published HIV/AIDS research by and on E&S Africa. It was noted that approximately 50% of the sources in each of the databases were common in both databases as shown in Fig 5.1. Four hundred and thirty records were common in the two databases, thus comprising a percentage contribution of 53.5% of the 804 sources in the MEDLINE database and 52.2% of the HIV/AIDS publishing sources in the ISI databases. Whereas the MEDLINE database indexed 374 unique items, the ISI databases yielded 393 sources that were not indexed in MEDLINE.

Fig 5.1: Distribution of sources by Database



MEDLINE = 804 ISI = 823

The coverage overlap, which is defined as journals or source publications indexed simultaneously by two indexing services, is mathematically expressed as the number of journals common to the two services. It may be calculated as the number of journals in A intersection B divided by the number of journals in A union B where A and B are lists of journals indexed by each of the two indexing services; A intersection B is the list of only those journals simultaneously indexed by the two indexing services; and A union B is the list of all journals indexed by one or the other or both indexing services (Diodato, 1994:53). Therefore the publication overlap between the MEDLINE and ISI databases, as far as HIV/AIDS publications are concerned, is:

$$\frac{430}{804 + 823 - 430} = \frac{430}{1197} = 0.36$$

Table 5.3: Distribution of records by document type

No.	Document type	Number records			
		MEDLINE (N=6178)		ISI (N=6367)	
		Papers	Percentage	Papers	Percentage
1	Journal Article	4770	77.21	5082	79.82
2	Letter	607	9.83	553	8.69
3	Review	329	5.33	273	4.29
4	News	495	8.01	58	0.91
5	Editorial	125	2.02	308	4.84
6	Comment	292	4.73	0	0.00
7	Meeting Abstract	0	0.00	265	4.16
8	Review, Tutorial	258	4.18	0	0.00
9	Clinical Trial	245	3.97	0	0.00
10	Newspaper Article	189	3.06	0	0.00
11	Case Reports	175	2.83	0	0.00
12	Randomized Controlled Trial	164	2.65	0	0.00
13	Note	0	0.00	95	1.49
14	Multicenter Study	89	1.44	0	0.00
15	Congresses	62	1.00	0	0.00
16	News item	58	0.94	0	0.00
17	Evaluation Studies	56	0.91	0	0.00
18	Historical Article	27	0.44	0	0.00
19	Interview	26	0.42	0	0.00
20	Controlled Clinical Trial	22	0.36	0	0.00
21	Book review	0	0.00	21	0.33
22	Biography	19	0.31	0	0.00
23	Correction	0	0.00	18	0.28
24	Validation Studies	13	0.21	0	0.00
25	Legal Cases	12	0.19	0	0.00
26	Multicase	8	0.13	0	0.00
27	Review of Reported Cases	5	0.08	0	0.00
28	Addresses	4	0.06	0	0.00
29	Lectures	4	0.06	0	0.00
30	Meta-Analysis	4	0.06	0	0.00
31	Consensus Development Conference	2	0.03	0	0.00
32	Guideline	2	0.03	0	0.00
33	Practice Guideline	2	0.03	0	0.00
34	Corrected and Republished Article	1	0.02	0	0.00
35	Technical Report	1	0.02	0	0.00
36	Correction, Addition	0	0.00	1	0.02
37	Software Review	0	0.00	1	0.02
38	Reprint	0	0.00	1	0.02

5.4.4 Distribution of HIV/AIDS Records by Document Type

The distribution of records according to the type of document was meant to determine the most used publication type in HIV/AIDS research in E&S Africa. In total, there were 38 types of documents. Whereas the MEDLINE database yielded 31 types, the ISI databases produced 12. Table 5.3 indicates that journal articles led with 4770 (77.21%) and 5082 (79.82%) records in the MEDLINE and ISI databases, respectively. Other highly ranked types were letters to the editor, reviews, news items, editorials, comments, and meeting abstracts.

5.4.5 Growth and Distribution of HIV/AIDS sources, 1980-2005

Table 5.4 shows the growth and distribution of HIV/AIDS source publications for each country in each database. Aside from instances during which the number of sources decreased in some countries, E&S African countries have generally witnessed continued growth in the number of sources that publish HIV/AIDS research in the last 2½ decades. This pattern is most apparent in countries that were highly ranked. For instance, MEDLINE sources that published HIV/AIDS research in South Africa increased from just 2 in 1983-1985, to 221 in 2001-2003, a percentage increase of 10950%. The same pattern was observed in ISI databases, where sources grew from 3 in 1983-1985, to 271 in 2001-2003, a percentage increase of 8933.3%. Similar patterns were recorded in Uganda which came second, Kenya in third, and Tanzania, Zimbabwe, Zambia, Malawi, and Ethiopia which ranked 4th, 5th, 5th, 6th, and 7th, respectively. Other countries had a mixed pattern of growth, i.e. a rise and fall pattern. The least productive countries were Lesotho, Somalia, Angola and Eritrea.

Table 5.4: Growth and Distribution of HIV/AIDS sources, 1980-2005

Rank			*Country*	*1980-1982*		*1983-1985*		*1986-1988*		*1989-1991*		*1992-1994*		*1995-1997*		*1998-2000*		*2001-2003*		*2004-2005*	
M	ISI	M&ISI		M	ISI	M	ISI	M	ISI	M	ISI	M	ISI	M	ISI	M	ISI	M	ISI	M	ISI
1	1	1	South Africa			2	3	11	10	34	25	52	54	85	86	154	160	221	271	152	242
2	2	2	Uganda	3		5		18	4	44	26	50	49	77	67	85	71	75	117	65	108
3	3	3	Kenya	1		5	1	18	9	32	26	37	43	48	61	57	78	72	84	49	77
4	4	4	Tanzania	1		2		12	5	28	13	45	38	57	52	58	73	48	91	40	81
6	5	5	Zimbabwe			1		7	4	32	17	43	38	44	48	41	43	49	90	32	63
5	6	5	Zambia			1		19	7	28	17	43	40	50	50	30	49	38	68	42	48
7	7	6	Malawi	1				2	1	12	9	24	19	35	40	34	43	40	66	46	58
8	8	7	Ethiopia	2				3	2	15	6	23	22	29	19	27	27	37	45	29	29
9	9	8	Botswana							2	1	6	3	9	2	16	11	33	43	24	27
10	10	9	Mozambique					3		4	2	5	6	12	5	4	8	13	16	9	12
11	11	10	Sudan	1		1		4	1	4	3	4	2	5	7	3	11	6	17	2	7
13	12	11	Swaziland							1	1	2	3	1	2	7	4	3	8	5	13
12	13	11	Namibia					1	1	2	1	2	3	8	5	8	8	5	6	3	3
14	14	12	Djibouti							4	5	6	3	1	4	1	5	2	2	2	2
17	15	13	Lesotho											2	2	2	3	4	6	4	4
16	16	13	Somalia					3	1	6	4	2	3		2	2	2		1	1	1
15	17	13	Angola					4	2	2	1	2		2	2		2	1	1	4	2
18	18	14	Eritrea													3	3	1		1	
			TOTAL	9	0	17	4	105	47	250	157	346	326	465	454	532	601	648	932	510	777

Key: **M = MEDLINE**
ISI = ISI's SCI and SSCI databases

Table 5.5: Average number of publications per source, 1980-2005

	1980-1982		1983-1985		1986-1988		1989-1991		1992-1994		1995-1997		1998-2000		2001-2003		2004-2005	
	M	ISI	M	ISI	M	ISI	M	ISI	M	ISI	M	ISI	M	ISI	M	ISI	M	ISI
Angola	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00
Botswana	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.33	1.00	1.38	2.09	1.39	1.35	1.33	1.70
Djibouti	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.20	1.17	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Eritrea	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.33	1.00	0.00	1.00	0.00
Ethiopia	1.00	0.00	0.00	0.00	1.33	1.50	1.40	2.33	1.61	1.41	1.55	1.95	1.67	2.19	2.14	2.11	1.24	1.45
Kenya	1.00	0.00	1.00	1.00	1.22	1.89	2.00	2.50	1.81	2.65	2.46	2.72	1.98	2.73	2.32	2.75	2.16	2.19
Lesotho	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**3.00**	1.00	1.00	1.33	1.00	1.17	1.25	1.00
Malawi	1.00	0.00	0.00	0.00	1.00	1.00	1.17	1.33	1.46	1.47	1.71	1.80	1.68	2.47	2.15	2.47	1.87	2.12
Mozambique	0.00	0.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.08	1.80	1.00	1.25	1.31	1.00	1.11	1.08
Namibia	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.13	1.00	1.00	1.00	1.00	1.17	1.00	1.00
Somalia	0.00	0.00	0.00	0.00	1.00	1.00	1.17	0.75	1.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
South Africa	0.00	0.00	**3.00**	**3.33**	2.91	2.40	**3.18**	2.80	2.69	2.37	2.65	2.44	**3.55**	**3.16**	**3.30**	2.87	2.75	2.42
Sudan	1.00	0.00	1.00	0.00	1.25	1.00	1.00	1.33	1.00	1.00	1.40	1.00	1.00	1.16	1.00	1.06	1.00	1.00
Swaziland	0.00	0.00	0.00	0.00	0.00	0.00	2.00	1.00	1.00	1.33	1.00	1.00	1.43	1.00	1.00	1.25	1.00	1.08
Tanzania	1.00	0.00	1.50	0.00	1.50	1.60	1.82	2.46	1.89	2.11	2.26	2.67	1.76	2.51	2.13	2.54	1.73	1.88
Uganda	1.00	0.00	2.00	0.00	1.61	1.75	1.82	1.81	2.30	2.53	2.22	2.15	2.27	**3.27**	2.61	2.70	2.34	2.35
Zambia	0.00	0.00	**5.00**	0.00	1.11	1.29	1.50	1.76	1.67	1.85	1.92	1.96	1.73	2.06	1.89	2.07	1.40	1.69
Zimbabwe	0.00	0.00	1.00	0.00	1.14	1.00	1.84	1.35	1.81	1.61	2.34	1.44	2.29	2.19	1.76	1.61	1.56	1.68
OVERALL	1.00	0.00	1.82	2.75	1.45	1.66	1.86	1.99	1.90	2.05	2.15	2.14	2.36	2.61	2.47	2.38	2.04	2.07

5.4.6 Average Number of Records per Source, 1980-2005

Another indicator that was used to measure the growth (or the lack thereof) and productivity of the source publications was the average number of records per source for the entire period of study. Overall, there were 804 sources that published 6178 records in the MEDLINE database, while 823 sources in the ISI produced 6367 records. Thus, the number of records per source was 7.68 in MEDLINE and 7.74 in ISI. This pattern was, however, not reflected in the annual analysis of records in Table 5.5. The highest number of records per publication (i.e. 5) was recorded by Zambia in 1983-1985, as highlighted in Table 6.5. Other high figures were mainly recorded by South Africa, whose average number of records per publication ranged between 2.37 and 3.55. Generally, it was noted that most figures stabilized, particularly between 1998 and 2005, in the case of most of the countries. It was also observed that recent years, specifically 1998-2000, 2001-2003 and 2004-2005, recorded high averages.

5.4.7 Geographic Distribution of Source Publications

The geographic distribution of sources is meant to provide insights into the countries in which HIV/AIDS research in E&S Africa is published whilst measuring research dissemination within E&S Africa. In the category of foreign countries (see Table 5.6), a total of 744 (92.54%) foreign sources in MEDLINE and 803 (97.57%) foreign sources in ISI published HIV/AIDS papers on and about E&S Africa. The USA was the most productive in both the MEDLINE and ISI databases. The country published 299 (37.19%) sources through MEDLINE and 320 (38.88%) via ISI. These figures constitute over one-third (1/3) of all the HIV/AIDS source publications. In second position was Great Britain (MEDLINE 223[27.74%], ISI 270[32.81%]), followed by the Netherlands, Switzerland, Germany and Denmark.

Table 5.6: Number of Foreign-based HIV/AIDS source publications

		MEDLINE (N=804)			ISI (N=823)		
No.	*Country*	*Rank*	*No. of sources*	*%*	*Rank*	*No. of sources*	*%*
1	USA	1	299	37.19	1	320	38.88
2	Great Britain	2	223	27.74	2	270	32.81
3	Netherlands	3	31	3.86	4	34	4.13
4	Switzerland	5	23	2.86	8	13	1.58
5	Germany	4	22	2.74	3	35	4.25
6	Denmark	5	19	2.36	6	19	2.31
7	France	7	16	1.99	5	20	2.43
8	Canada	8	14	1.74	8	10	1.22
9	Ireland	7	12	1.49	7	14	1.70
10	Norway	9	11	1.37	11	6	0.73
11	Japan	9	9	1.12	13	4	0.49
12	Australia	9	9	1.12	9	8	0.97
13	Italy	10	9	1.12	10	7	0.85
14	Russia	11	6	0.75	15	2	0.24
15	Spain	12	5	0.62	13	4	0.49
16	Israel	12	4	0.5	15	2	0.24
17	India	12	4	0.5	14	3	0.36
18	Sweden	13	3	0.37	-	0	0.00
19	Belgium	13	3	0.37	16	1	0.12
20	Brazil	15	3	0.37	16	1	0.12
21	Greece	14	2	0.25	12	5	0.61
22	Austria	14	2	0.25	15	2	0.24
23	Ukraine	15	1	0.12	-	0	0.00
24	Turkey	15	1	0.12	16	1	0.12
25	Slovakia	15	1	0.12	15	2	0.24
26	Singapore	15	1	0.12	16	1	0.12
27	Poland	15	1	0.12	14	3	0.36
28	Papua New Guinea	15	1	0.12	16	1	0.12
29	New Zealand	15	1	0.12	13	4	0.49
30	New Caledonia	15	1	0.12	-	0	0.00
31	Hungary	15	1	0.12	-	0	0.00
32	Hong Kong	15	1	0.12	-	0	0.00
33	Czech Rep	15	1	0.12	-	0	0.00
34	China	15	1	0.12	15	2	0.24
35	Chile	15	1	0.12	-	0	0.00
36	Bangladesh	15	1	0.12	16	1	0.12
37	Finland	-	1	0.12	16	1	0.12
38	Saudi Arabia	-	0	0	15	2	0.24
39	Croatia	-	0	0	16	1	0.12
40	Korea	-	0	0	16	1	0.12
41	Mexico	-	0	0	16	1	0.12
42	U Arab Emirates	-	0	0	16	1	0.12
43	Venezuela	-	0	0	16	1	0.12
	TOTAL		**744**	92.54		**803**	97.57

Regionally, only 8 countries contributed to the publication of 30 (3.73%) sources in the MEDLINE and 18 (2.19%) in the ISI databases, as shown in Table 5.7. South Africa came first with 16 (1.99%) sources in MEDLINE and 14 (1.70%) in the ISI databases. Other countries include Kenya (MEDLINE $4_{[0.50\%]}$, ISI $2_{[0.24\%]}$), Zimbabwe (MEDLINE $2_{[0.25\%]}$, ISI $1_{[0.12\%]}$), Nigeria (MEDLINE $2_{[0.25\%]}$), Malawi (MEDLINE $2_{[0.25\%]}$), Egypt (MEDLINE $2_{[0.25\%]}$), Uganda (MEDLINE $1_{[0.12\%]}$), and Ethiopia (MEDLINE $1_{[0.12\%]}$, ISI $1_{[0.12\%]}$). This analysis excludes 30 MEDLINE and 2 ISI sources which lacked information on the origins of publication.

Table 5.7: Number of Regional-based HIV/AIDS source publications

			MEDLINE (N=804)			*ISI (N=823)*	
No.	***Country***	***Rank***	***No. of sources***	***%***	***Rank***	***No. sources***	***%***
1	South Africa	1	16	1.99	1	14	1.70
2	Kenya	2	4	0.50	2	2	0.24
3	Zimbabwe	3	2	0.25	3	1	0.12
4	Nigeria	3	2	0.25	-	-	0.00
5	Malawi	3	2	0.25	-	-	0.00
6	Egypt	3	2	0.25	-	-	0.00
7	Uganda	4	1	0.12	-	-	0.00
8	Ethiopia	4	1	0.12	3	1	0.12
	TOTAL		**30**	**3.73**		**18**	**2.19**

5.4.8 Productivity of Source Publications

Table 5.8 provides the number of records each source produced between 1980 and 2005. The 10 most productive journals in the ISI, in descending order, are AIDS (633), Lancet (297), S AFR MED J (273), J INFEC DIS (228), EAST AFR MED J (220), INT J TUBER LUNG DIS (180), AIDS RES HUM RETROVIRUS (172), J ACQ IMMUN DEFIC SYND [JAIDS] (171), INT J STD AIDS (135), and TRANS ROY SOC TROP MED HYG (128). Apart from three titles that ranked among the top ten most productive sources in MEDLINE, all the rest featured among the top 10 ranked sources in ISI. A notable difference between the two sources of data is the positions the most productive sources take. For instance, whereas the S AFR MED J ranked first in MEDLINE, it ranked 3rd in the ISI databases.

Table 5.8: Top ranked sources by the number of papers, 1980-2005

ISI			Medline		
Rank	Source	No. of papers	Rank	Source	No. of papers
1	AIDS	633	1	S Afr Med J	457
2	Lancet	297	2	AIDS	442
3	S Afr Med J	273	3	Lancet	422
4	J Infec Dis	228	4	J Acquir Immune Defic Syndr	212
5	East Afr Med J	220	5	AIDS Anal Afr	164
6	Int J Tuberc Lung Dis	180	6	East Afr Med J	157
7	AIDS Res Hum Retrovirus	172	7	J Infect Dis	147
8	J Acq Immun Defic Synd (JAIDS)	171	8	AIDS Res Hum Retroviruses	130
9	Int J Std Aids	135	9	AIDS Care	119
10	Trans Roy Soc Trop Med Hyg	128	10	Brit Med J	109
11	AIDS Care	111	11	Cent Afr J Med	106
12	Soc Sci Med	98	12	Int J STD AIDS	103
13	Clin Infect Dis	96	13	Trans R Soc Trop Med Hyg	82
14	Sex Transm Dis	92	14	Soc Sci Med	75
15	Sex Transm Infect	87	15	Trop Doct	71
15	Brit Med J	87	16	Int J Tuberc Lung Dis	68
16	Trop Med Int Health	74	17	Nature	67
17	Bull WHO	72	18	Bull World Health Organ	59
18	J Virol	68	19	Trop Med Int Health	55
29	Trop Doc	62	20	Pediatr Infect Dis J	44
20	Ethiopian Med J	60	21	Ethiop Med J	43
21	Pediat Inf Dis J	59	22	Nurs RSA	43
22	J Clin Microbiol	56	23	Sex Transm Dis	42
23	Amer J Trop Med Hyg	54	24	Can HIV AIDS Policy Law Rev	40
24	J Dent Res	48	25	Am J Trop Med Hyg	35
25	Genitourin Med	44	26	Science	33
25	Reprod Health Matters	44	27	Lancet Infect Dis	32
26	S Afr J Sci	42	28	Sex Transm Infect	30
27	J Trop Pediat	38	29	Health Transit Rev	29
28	J Med Virol	37	29	J Med Virol	29
29	Health Policy Plann	36	30	AIDS Policy Law	28
30	Int J Epidemiol	35	30	Clin Infect Dis	28
30	Ann Trop Paediat	35	31	AIDS Wkly Plus	27
31	Clin Diagn Lab Immunol	32	31	N Engl J Med	27
31	Tubercle Lung Dis	32	32	J Clin Microbiol	26
31	Amer J Public Health	32	32	J Trop Pediatr	26
32	Arch Dis Child	31	33	Ann Trop Paediatr	25
33	AIDS Educ Prev	30	33	Nat Med	25
34	JAMA – J Amer Med Ass	28	34	AIDS Action	24

5.4.9 Journal Influence

Journal influence was measured by the number of citations that a journal received and the journal's citation impact. Both regional and international influence was measured. Among the journals that published HIV/AIDS research in E&S Africa, the NEW ENGL J MED had the highest IF of 38.57 from 159498 citations received in 2002 and 2003. NATURE, SCIENCE, and NATURE MED came 2nd, 3rd, and 4th, respectively, with IF's of 32.182, 31.853, and 31.223 from 363374, 332803, 38657 citations that they earned between 2002 and 2003. Notably, local journals did not feature among the top 52 journals. S AFR MED J was 55th with 2143 citations from a total of 65 papers published between 2002 and 2003. The journal recorded 32.97 citations per paper, an IF of 1.107, Immediacy Index of 1.123 and Cited Half Life of >10. The next African journal covered in the 2004 JCR was the Ethiopian Medical Journal, which received 153 citations from 28 papers, producing average citations per paper of 5.46, an IF of 0.174, Immediacy Index of 0.071 and Cited Half Life of 8.8. Other African journals that ranked highly in Table 5.8 were not covered in the 2004 JCR, as shown in Table 5.9.

Column 3 in Table 5.10 contains cites that the ranked sources received from the 823 sources that published HIV/AIDS literature in E&S Africa. Column 5 provides the number of cites that the 823 sources received. Whereas the former provides information on the sources researchers in E&S Africa use to conduct their HIV/AIDS research activities, the latter analysis measures the scientific impact of HIV/AIDS research that is conducted in and about E&S Africa by totaling the number of cites the papers published in each source received. Table 5.9 shows that the most used journal by HIV/AIDS researchers was *AIDS*, which received 11576 citations, followed by LANCET (9492), J INFEC DIS (4802), NEW ENGL J MED (4093), J VIROL (2960), and the J ACQ IMMUN DEF SYND (2847).

Table 5.9: Scientific Impact of HIV/AIDS Journals Ranked by the Impact Factor

		2004 Journal Citation Reports (JCR)					
Rank	***Journal***	***No. of Cites***	***No. of Papers***	***Journal Average Cites***	***Impact Factor***	***Immediacy Index***	***Cited Half Life***
1	NEW ENGL J MED	159498	316	504.7405	38.570	10.478	6.9
2	NATURE	363374	878	413.8656	32.182	6.089	7.2
3	SCIENCE	332803	845	393.8497	31.853	7.379	7.0
4	NATURE MED	38657	168	230.1012	31.223	5.720	4.7
5	JAMA-J AM MED ASSOC	88864	351	253.1738	24.831	5.499	6.3
6	LANCET	126002	415	303.6193	21.713	5.827	6.8
7	J EXP MED	63416	321	197.5576	14.588	2.436	7.0
8	J CLIN INVEST	78271	350	223.6314	14.204	2.554	7.8
9	J NATL CANCER INST	29516	159	185.6352	13.856	3.031	7.0
10	ANN INTERN MED	36932	189	195.4074	13.144	3.545	8.6
11	P NATL ACAD SCI USA	345309	3084	111.9679	10.452	1.923	6.7
12	AM J RESP CRIT CARE	33673	330	102.0394	8.123	2.824	5.0
13	ARCH INTERN MED	26525	282	94.0603	7.508	1.262	7.0
14	BRIT MED J	56807	623	91.1830	7.038	3.039	7.3
15	J IMMUNOL	108602	1793	60.5700	6.486	1.096	5.5
16	AIDS	17503	359	48.7549	5.893	1.128	4.5
17	CLIN INFECT DIS	23917	431	55.4919	5.594	1.684	4.6
18	AM J CLIN NUTR	26010	377	68.9920	5.433	0.960	7.3
19	J VIROL	74388	1464	50.8115	5.398	0.985	5.9
20	J INFECT DIS	32704	581	56.2892	4.943	1.105	6.5
21	AM J EPIDEMIOL	22292	266	83.8045	4.933	0.842	9.2
22	CANCER	49773	627	79.3828	4.434	0.770	9.8
23	INT J CANCER	29420	667	44.1079	4.416	0.826	5.7
24	ANTIMICROB AGENTS CH	28261	786	35.9555	4.216	0.800	5.8
25	AM J MED	21000	285	73.6842	4.179	1.053	>10
26	J ACQ IMMUN DEF SYND	7267	243	29.9053	4.100	0.646	4.4
27	INFECT IMMUN	44011	929	47.3746	4.033	0.633	6.4
28	PEDIATRICS	28316	661	42.8381	3.903	0.935	6.6
29	INT J EPIDEMIOL	7079	130	54.4538	3.735	1.962	7.3
30	OBSTET GYNECOL	17298	310	55.8000	3.512	0.716	8.7
31	J CLIN MICROBIOL	35117	1090	32.2174	3.439	0.486	5.9
32	AM J PUBLIC HEALTH	17066	303	56.3234	3.241	0.723	8.1
33	CHEST	27826	654	42.5474	3.118	0.534	7.0
34	J PEDIATR	18634	289	64.4775	3.117	0.761	>10
35	VIROLOGY	24285	498	48.7651	3.071	0.500	8.2
36	B WORLD HEALTH ORGAN	5226	102	51.2353	2.870	0.814	8.8
37	PEDIATR INFECT DIS J	7523	259	29.0463	2.735	0.564	6.0
38	CLIN EXP IMMUNOL	9773	305	32.0426	2.518	0.459	7.6
39	AM J OBSTET GYNECOL	24490	577	42.4437	2.437	0.369	9.5
40	AIDS RES HUM RETROV	4575	177	25.8475	2.375	0.367	6.0
41	J MED VIROL	5514	279	19.7634	2.331	0.366	5.3
42	SEX TRANSM INFECT	1433	122	11.7459	2.204	0.541	3.7
43	SOC SCI MED	12756	419	30.4439	2.088	0.413	7.9
44	SEX TRANSM DIS	2884	127	22.7087	2.081	0.299	5.5
45	AM J TROP MED HYG	9348	288	32.4583	2.013	0.344	8.6
46	TROP MED INT HEALTH	2148	176	12.2045	1.969	0.409	4.2
47	TUBERCLE	357	41	8.7073	1.935	0.805	2.9
48	T ROY SOC TROP MED H	5772	108	53.4444	1.746	0.639	>10.0
49	CLIN DIAGN LAB IMMUN	2767	196	14.1173	1.724	0.337	4.3
50	ARCH DIS CHILD	10752	407	26.4177	1.656	0.418	8.5
51	INT J STD AIDS	1788	164	10.9024	1.506	0.384	4.3
52	INT J TUBERC LUNG D	2262	216	10.4722	1.484	0.380	4.3

Table 5.10: Most used sources in E&S Africa, 1980-2005

No.	Journal	No. of Cites in AIDS papers	Journal Average Cites	Total Cites (N=72450)	%
1	AIDS	11576	20.3826	12413	17.13
2	LANCET	9492	34.8071	9746	13.45
3	J INFECT DIS	4802	23.424	5242	7.24
4	NEW ENGL J MED	4093	72.64	1816	2.51
5	J VIROL	2960	37.0735	2521	3.48
6	J ACQ IMMUN DEF SYND	2847	12.5172	2305	3.18
7	JAMA-J AM MED ASSOC	2688	42.6296	1151	1.59
8	AIDS RES HUM RETROV	2198	13.4096	2226	3.07
9	SCIENCE	2150	9.3571	131	0.18
10	BRIT MED J	2121	16.4524	1382	1.91
11	S AFR MED J	1804	4.7625	1377	1.90
12	SOC SCI MED	1693	9.9792	958	1.32
13	J CLIN MICROBIOL	1648	17.8462	928	1.28
14	T ROY SOC TROP MED H	1391	9.2066	1114	1.54
15	NATURE	1288	4.1667	25	0.03
16	CLIN INFECT DIS	1253	10.5111	946	1.31
17	ANN INTERN MED	1250	59.3333	178	0.25
18	B WORLD HEALTH ORGAN	1225	9.125	657	0.91
19	INT J TUBERC LUNG D	1220	6.5932	1167	1.61
20	SEX TRANSM DIS	1149	10.5517	918	1.27
21	P NATL ACAD SCI USA	1141	27.6667	83	0.11
22	TUBERCLE LUNG DIS	1081	24.5313	785	1.08
23	AM REV RESPIR DIS	1010	80	560	0.77
24	J IMMUNOL	1006	45.5556	410	0.57
25	INT J STD AIDS	989	7.7023	1009	1.39
26	PEDIATR INFECT DIS J	933	13.6724	793	1.09
27	AM J PUBLIC HEALTH	909	15.0645	467	0.64
28	E AFR MED J	876	3.8182	630	0.87
29	GENITOURIN MED (1999)	861	15.4773	681	0.94
30	AIDS CARE	786	5.0561	541	0.75
31	NATURE MED	710	44.2222	398	0.55
32	AM J TROP MED HYG	636	20.7778	1122	1.55
33	VIROLOGY	599	23.1538	301	0.42
34	J EXP MED	593	47.25	189	0.26
35	AM J EPIDEMIOL	584	7.3636	81	0.11
36	INT J EPIDEMIOL	571	11.6571	408	0.56
37	INT J CANCER	514	33.9375	543	0.75
38	PEDIATRICS	498	10.5	84	0.12
39	J PEDIATR	495	42.6	213	0.29
40	AM J CLIN NUTR	489	7.6429	107	0.15
41	SEX TRANSM INFECT	481	11.382	1013	1.40
42	ARCH INTERN MED	462	52.25	418	0.58
43	TROP MED INT HEALTH	454	4.8875	391	0.54
44	AM J OBSTET GYNECOL	441	14.2	142	0.20
45	J CLIN INVEST	437	67	402	0.55
46	AM J RESP CRIT CARE	424	13.2778	239	0.33
47	J MED VIROL	419	10.5882	360	0.50
48	INFECT IMMUN	416	21.125	169	0.23
49	AM J MED	385	5	5	0.01
50	CLIN EXP IMMUNOL	376	13.7692	179	0.25
51	STUD FAMILY PLANN	376	5.7059	97	0.13
52	ANTIMICROB AGENTS CH	355	16.4286	115	0.16
53	ARCH DIS CHILD	341	8.9655	260	0.36
54	CHEST	317	7.6	38	0.05

A total of 75450 citations were received by the 823 sources that published HIV/AIDS research in E&S Africa. The lion's share of these citations went to AIDS, whose HIV/AIDS papers attracted a total of 12413 (17.3%) citations. LANCET was second with 9746 (13.45%) citations, followed by J INFEC DIS (5242 or 7.24%), J VIROL (2521 or 3.48%), J ACQ IMMUN DEF SYND (2305 or 3.18%), AIDS RES HUM RETROV (2226 or 3.07), and NEW ENGL J MED (1816 or 2.51%).

It is worth noting that the S AFR MED J and the E AFR MED J, which ranked poorly in the JCR (Table 5.9), were among the most consulted journals by researchers conducting HIV/AIDS research in and about E&S Africa (see Table 5.10). The S AFR MED J was used 1804 times, while the E AFR MED J attracted 876 citations. Other local journals that performed fairly well were the CENT AFR J MED and the ETHIOPIAN MED J which received 238 and 225 citations, respectively. With regard to the total number of citations that the HIV/AIDS papers published in these sources received during the study period, the S AFR MED J was leading with 1377 citations, which accounted for 0.22% of the total 75450 citations received by the 823 sources that published HIV/AIDS research in E&S Africa. The second listed journal was the E AFR MED J, which attracted 630 (0.10) citations, followed by ETHIOPIAN MED J (128 or 0.02%) and CENT AFR J MED (64 or 0.01%).

5.4.10 Distribution of Sources by Subject Category

Data was analyzed according to the subject categories of source-affiliation in order to measure the multidiciplinarity of HIV/AIDS as well as the subjects or disciplines that utilize HIV/AIDS research. There were 49 broad subject categories in which HIV/AIDS research was published. Table 5.11 reveals that most of the sources belonged to the Medical Sciences category which produced 488 (60.70%) and 462 (56.14%) sources in the MEDLINE and ISI databases, respectively. 2nd was Biology (MEDLINE 81 [10.07%], ISI 101 [12.27%]) followed by *Public Health and Safety* with 32 (3.98%) and 31 (3.77%) sources in the MEDLINE and ISI databases, respectively. Others were *Pharmacy and Pharmacology* (MEDLINE 18 [2.24%], ISI 23 [2.79%]), *Business and Economics*

(MEDLINE 18 [2.24%], ISI 20 [2.43%]), *Psychology* (MEDLINE 16 [1.99%], ISI 22 [2.67%]) and *Nutrition and Dietetics* (MEDLINE 11 [1.37%], ISI 14 [1.70%]).

Table 5.11: Distribution of the Source Publications by Main Subject Categories

No		MEDLINE		ISI	
	Main Subject	***No. of sources***	***Percentage***	***No. of Sources***	***Percentage***
1	Medical Sciences	488	60.70	462	56.14
2	Biology	81	10.07	101	12.27
3	Public Health and Safety	32	3.98	31	3.77
4	Pharmacy and Pharmacology	18	2.24	23	2.79
5	Business and Economics	18	2.24	20	2.43
6	Psychology	16	1.99	22	2.67
7	Nutrition and Dietetics	11	1.37	14	1.70
8	Chemistry	10	1.24	13	1.58
9	Education	8	1.00	12	1.46
10	Social Services and Welfare	12	1.49	8	0.97
11	Sciences - Comprehensive works	6	0.75	11	1.34
12	Population Studies	7	0.87	7	0.85
13	Social Sciences	3	0.37	11	1.34
14	Women's Health	10	1.24	4	0.49
15	Law	12	1.49	1	0.12
16	Veterinary Science	5	0.62	7	0.85
17	Anthropology	5	0.62	6	0.73
18	General interest periodicals	10	1.24	0	0.00
19	Political Science	2	0.25	8	0.97
20	Sociology	3	0.37	6	0.73
21	Agriculture	3	0.37	5	0.61
22	Geography	1	0.12	7	0.85
23	Occupational Health and Safety	3	0.37	5	0.61
24	Philosophy	7	0.87	0	0.00
25	Birth Control	4	0.50	2	0.24
26	Engineering	1	0.12	5	0.61
27	Health Facilities and Administration	5	0.62	1	0.12
28	Drug Abuse and Alcoholism	1	0.12	4	0.49
29	Computers	0	0.00	4	0.49
30	Environmental studies	1	0.12	3	0.36
31	Gerontology and Geriatrics	2	0.25	2	0.24
32	Statistics	1	0.12	3	0.36
33	Alternative Medicine	2	0.25	1	0.12
34	History	2	0.25	1	0.12
35	Housing and Urban Planning	2	0.25	1	0.12
36	Mathematics	0	0.00	3	0.36
37	Religion and Theology	3	0.37	0	0.00
38	Children and Youth	1	0.12	1	0.12
39	Handicapped	1	0.12	1	0.12
40	Linguistics	1	0.12	1	0.12
41	Technology	1	0.12	1	0.12
42	Water Resources	0	0.00	2	0.24
43	Women's Studies	1	0.12	1	0.12
44	Beauty Culture	0	0.00	1	0.12
45	Clubs	1	0.12	0	0.00
46	Fish and Fisheries	0	0.00	1	0.12
47	Humanities	1	0.12	0	0.00
48	Metrology and Standardization	1	0.12	0	0.00
49	Women's Interests	1	0.12	0	0.00
	TOTAL	**804**	**100.00**	**823**	**100.00**

Table 5.12: Distribution of the Source Publications by Subcategories of Medical Sciences

NO.	RANKING			SUBJECISI	MED		ISI	
	MED	*TH SCI*	*Overall*		Sources	Papers	Sources	Papers
1	1	1	1	Medical Sciences (General)	132	1862	138	1578
2	2	2	2	Communicable Diseases	72	1734	44	1967
3	4	4	3	Obstetrics and Gynecology	27	103	26	124
4	6	3	4	Allergology and Immunology	24	98	29	148
5	5	6	5	Oncology	25	43	21	53
6	8	5	6	Psychiatry and Neurology	17	31	23	45
7	7	7	7	Pediatrics	21	154	20	219
8	3	12	8	Nurses and Nursing	44	196	9	22
9	10	7	9	Surgery	11	26	20	44
10	11	8	10	Gastroenterology	10	15	13	37
11	9	11	11	Dentistry	14	67	10	90
12	10	11	12	Respiratory Diseases	11	135	10	263
13	13	9	13	Hematology	7	9	12	20
14	12	11	14	Dermatology and Venereology	9	124	10	22
15	13	10	14	Rheumatology	7	16	11	30
16	12	15	15	Cardiovascular Diseases	9	19	6	14
17	14	13	15	Orthopedics and Traumatology	6	14	8	19
18	14	14	16	Ophthalmology and Optometry	6	11	7	14
19	16	13	17	Radiology and Nuclear Medicine	4	5	8	11
20	15	16	18	Otorhinolaryncology	5	9	5	7
21	14	17	18	Experimental, Medicine, Laboratory Technique	6	10	4	9
22	17	15	19	Endocrinology	3	3	6	219
23	17	15	19	Urology and Nephrology	3	4	6	9
24	15	17	19	Forensic Sciences	5	6	4	9
25	17	17	20	Internal Medicine	3	6	4	13
26	17	18	21	Abstracting, Bibliographies, Statistics	3	29	2	11
27	18	18	22	Anaesthesiology	2	2	2	2
28	19	18	23	Computer Applications	1	1	2	3
29	19	19	24	Physical Medicine and Rehabilitation	1	2	1	2
30	20	19	25	Cardiology			1	1
				TOTAL	488	4734	462	5005

A special analysis was conducted on the Medical Sciences-oriented sources. Table 5.12 provides the distribution pattern of the sources that fall under the category of *Medical Sciences.* Overall, there were 30 subcategories of *Medical Sciences,* to which a total of 488 and 462 HIV/AIDS sources in MEDLINE and ISI belonged. The leading subject sub-category was *Medical Sciences (General),* which recorded the highest posting of 132 and 138 sources in the MEDLINE and ISI databases. *Communicable Diseases* yielded 72 sources in MEDLINE and 44 sources in ISI, followed by *Obstetrics and Gynaecology* (MEDLINE 27, ISI 26), *Allergology & Immunology* (MEDLINE 24, ISI 29), *Oncology*

(MEDLINE 25, ISI 21), *Psychiatry and Neurology* (MEDLINE 17, ISI 23), *Pediatrics* (MEDLINE 21, ISI 20), and *Nurses and Nursing* (MEDLINE 44, ISI 9).

5.4.11 Core Sources of HIV/AIDS research in E&S Africa

Table 5.13 compares the HIV/AIDS core sources in the MEDLINE and ISI databases to the total number of papers each Bradford zone produced. Zone 1, which is commonly known as Bradford's nucleus, consisted of 8 (1.00%) sources in MEDLINE and 9 (1.09%) sources in ISI. Zone 2 comprised 47 (5.85%) and 38 (4.62%) sources, while Zone 3 produced 749 (93.15%) and 776 (94.29%) sources in the MEDLINE and ISI databases, respectively. It follows that approximately 1% of the sources accounted for between 31% and 35% of the total papers, and about 99% of the sources produced between 64% and 69% of the HIV/AIDS papers in both databases.

Table 5.13: Distribution of sources according to Bradford's Zones using Papers

	ISI		MEDLINE	
	Sources	Papers	Sources	Papers
Zone 1	9 (1.09%)	2163 (34.54%)	8 (1.00%)	1970 (31.89%)
Zone 2	38 (4.62%)	2015 (32.17%)	47 (5.85%)	2105 (34.07%)
Zone 3	776 (94.29%)	2085 (32.29%)	749 (93.15%)	2103 (34.04%)
TOTAL	823 (100%)	6263 (100%)	804 (100%)	6178 (100%)

In terms of citations, a total of 18374 sources were cited by journals publishing HIV/AIDS research in/on E&S Africa between 1980 and 2005. In other words, authors of HIV/AIDS publications in and about E&S African countries used a total of 18374 sources to prepare the papers. These sources recorded 149631 citations in total, which amounts to approximately 8 citations per source. An analysis of these sources indicated that only 5.5% (i.e. 1016) of the sources accounted for 80% (i.e. 119704) of the citations. Table 5.14 provides the distribution of sources according to Bradford's zones. The results in Zone 1 show that 13 (0.07%) accounted for one-third (i.e. 50072 or 33.46%) of the total citations. Zone 2 consisted of 194 (1.06%) sources which attracted about one-third (i.e. 49840 or 33.31%) of the total citations, while Zone 3 produced 181167 (98.87%) sources which received 49719 (33.23%) citations.

Table 5.14: Distribution of sources according to Bradford's Zones using citations

	Sources		***Citations***	
	No. of sources	Percentage	No. of citations	Percentage
Zone 1	13	0.07	50072	33.46
Zone 2	194	1.06	49840	33.31
Zone 3	18167	98.87	49719	33.23
TOTAL	18374	100.00	149631	100.00

5.5 Discussion of the findings

Ulrich's Periodical Directory reveals that E&S Africa published a total of 1393 periodicals in April 2006, the period during which publications were accessed by the researcher. Of comfort was the observation that scholarly/academic periodicals were the majority, having recorded 546 postings. These source publications are commonly used in the dissemination of scholarly or scientific findings. Behrens (2000:226) observes that scholarly periodicals "*concentrate on articles which inform and report*". Articles published by scholarly periodicals, argues the author, are "*usually based on research findings and in such cases the article often becomes the first permanent record of these findings*" (Behrens, 2000:226). Equally important, particularly in biomedical research, are newspapers and newsletters. According to Lewison (2001:179), newspapers are increasingly becoming major sources of information on biomedical research. Their audience constitutes politicians, healthcare professionals, the general public (who are increasingly becoming active consumers of healthcare products) and other researchers who may value the immediacy of newspaper reports. (Lewison, 2001:179) notes that "*Newspaper articles tend to focus on fashionable topics and to offer premature hopes of cures to disease, but they can also provide a valuable service in showing the importance of animal experiments to biomedical progress*". As such, this study found that newspaper articles were the second most used document types in disseminating HIV/AIDS research findings.

The number of source publications published in a country may have a bearing on a country's research output. Perhaps that is why South Africa had a higher research output than any other country in the two regions of study. In contrast, Table 5.1 revealed the absence of source publications in Somalia. Whether this could be attributed to lack of information regarding sources published in the county or to the fact that the country does not actually publish any publications could not be confirmed. Nevertheless, it is common knowledge that for a long time, the country has been at war with itself, a situation that may have prevented the production of periodicals, and other developmental activities.

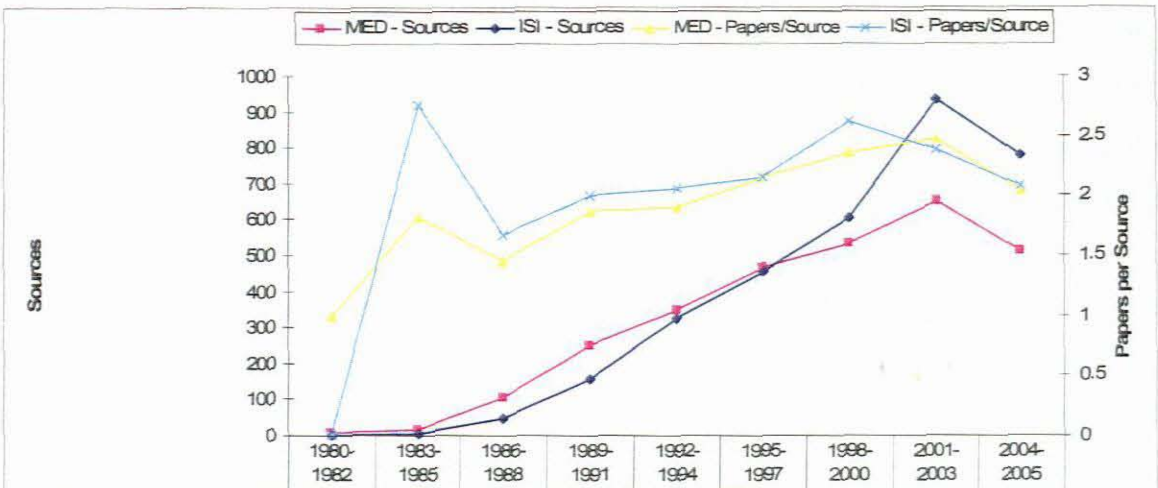
The coverage of these sources shows that only 14 (0.93%) and 28 (2.01%) sources that are published in E&S Africa are indexed in MEDLINE and ISI, respectively. Most of the indexed sources are published in South Africa, although the ratio of these to the total sources published in the country is relatively small. The dismal coverage of African source publications in the databases has much to do with the approaches used to select sources for the indexing services. Whereas the ISI databases use the vast reserves of information at their disposal (i.e. through highly cited journals) to select journals, MEDLINE's sources are selected via a review committee known as the Literature Selection Technical Review Committee. The Committee is composed of fifteen authorities who include physicians, researchers, educators, editors, health sciences librarians and historians knowledgeable in biomedicine and the life sciences (National Institutes of Health, 2005). ISI, besides using citation analysis to select journals, considers several other factors to assess whether a publication is influential enough to be included in its databases. These factors include editorial content, peer review, timeliness of publication and internationality. Whether most of the journals published in E&S Africa are not included in the databases for not meeting the above criteria was not reflected in the data. In the case of MEDLINE, one could argue that the database is subject-specific and therefore can cover only biomedical journals.

The coverage of HIV/AIDS source publications was evenly distributed in the two indexing services. Each database (i.e. MEDLINE and ISI databases) indexed an almost equal number of HIV/AIDS sources. Coverage overlap was relatively high. Approximately 50% of the titles indexed in each database were common. This of course has serious implications for collection development librarians, especially when making decisions on database subscription, considering the considerable expenses associated with electronic databases - particularly for institutions in developing countries. It is easier to decide on a database to subscribe to if the common sources are few, i.e., below 20%. In that case, one may decide to subscribe to both databases. Otherwise, subscription to databases that index over 50% of each other's indexed items is problematic.

An analysis of data by document type was meant to identify the source publications most used to disseminate HIV/AIDS research. However, this approach provided partial results, given that some document types could not identify the type of source publication. For instance, the document type "editorial" could be journal - or newspaper-affiliated. Nevertheless, results identified journals as the most used means of disseminating HIV/AIDS research findings. Other publications included newspapers, conferences and conference proceedings, and books.

With regard to the growth of sources publishing HIV/AIDS papers on and by E&S Africa, results show that most countries have witnessed considerable growth in the number of sources that publish papers emanating from or written about the respective countries. An exponential growth rate was also observed in the general trend of source publications as illustrated in the last row of Table 5.4 and Fig 5.2. The rapid and continued growth rate of the sources may be attributed to the growth and/or expansion of the databases that index the sources, i.e. the actual number of sources actually indexed/included by MEDLINE and ISI. A further notable observation was that the average number of papers per source maintained an upward trend throughout the study period (see Fig 5.2).

Fig 5.2: Growth of source publications



	1980-1982	1983-1985	1986-1988	1989-1991	1992-1994	1995-1997	1998-2000	2001-2003	2004-2005
MED - Sources	9	17	105	250	346	465	532	648	510
ISI - Sources	0	4	47	157	326	454	601	932	777
MED - Papers/Source	1	1.82	1.45	1.86	1.9	2.15	2.36	2.47	2.04
ISI - Papers/Source	0	2.75	1.66	1.99	2.05	2.14	2.61	2.38	2.07

Publication Year

Similar findings were observed in previous studies (Self, Fildardo & Lancaster 1989; Pratt, 1992). The two studies reported a rapid growth in the number of journals that publish HIV/AIDS literature on an international level. Pratt (1992) observed that the number of journals indexed by MEDLINE rose quickly from 17 in 1982 to 217 in 1983, and by the year 1990, more than 2000 journals had published at least one HIV/AIDS article. Self, Fildardo & Lancaster (1989) had similarly observed that only 14 journals published HIV/AIDS papers in 1982. This figure surged, and within a 5 year span, reached 1170. Comparatively, HIV/AIDS research was published in 9 sources in the MEDLINE database while the ISI produced no results between 1980 and 1982. By 1991, the MEDLINE database indexed 250 sources, while ISI indexed 157 sources that published HIV/AIDS papers in/on E&S Africa. The implications of such rapid growth for libraries and librarians are enormous. In terms of the budgetary allocation, librarians cannot afford to purchase even one-quarter (1/4) of the total number of sources and that is why they would need to be very selective in what sources they acquire. It has been argued that only one-third (1/3) of the sources are a core of a subject domain.

The geographic distribution of sources produced interesting results. It was found that most sources publishing HIV/AIDS research are published in foreign countries. Foreign published sources totaled 744, accounting for 92.54%, against Africa's 30 (3.73%) sources in the MEDLINE database while the ISI yielded 803 (97.57%) and 18 (2.19%) foreign and regional sources, respectively. Even within the "foreign" category, the distribution was skewed in favor of the USA and Great Britain. The two countries published over 65% of the total source publications in each database. Some writers are of the opinion that this pattern is influenced by the desire of authors from developing countries to publish their research findings in foreign (or international) sources, which are considered to be of more superior quality than regionally published sources (Onyancha & Ocholla, 2004a). The pattern could also be attributed to the journal selection process criteria used by the indexing services. It has also been observed that most of the sources indexed in the MEDLINE and ISI databases originate largely from the USA and Great Britain, most likely because these databases are published in the USA.

Productivity per source publication revealed the participation of both foreign and local sources in the publication of HIV/AIDS papers. Local journals that were among the top 10 included the S AFR MED J (South Africa) and the E AFR MED J (Kenya). Other local sources that were highly ranked (in the top 40) were CENT AFR J MED (Zimbabwe), ETHIOPIAN MED J (Ethiopia) and the S AFR J SCI (South Africa). The argument that local researchers prefer publishing in foreign journals is not entirely true in HIV/AIDS research given that locally published sources published a relatively large number of papers. In fact, the S AFR MED J was ranked as the most productive source in the MEDLINE database and came 3rd in the ISI databases. The E AFR MED J also performed adequately, coming 5th and 6th in ISI and MEDLINE, respectively. If we calculated the proportion of the locally published sources' contribution to the total number of publications in the top 40 ranked sources in Table 5.7, the 6 journals contributed 763 (or 23.7%) – out of 3224 (in the case of MEDLINE) and 593 (or 14.6%) – out of 4057 (in the case of ISI). A further observation was that most of the sources that ranked highly are general medical sources, followed by specialty journals (i.e. AIDS-specific journals). The emergence of AIDS-specific sources among the top sources in the late 1980s was previously noted by Bierbaum & Brooks (1995). As the authors stated, the fact that these sources are increasingly becoming major publishers of HIV/AIDS research, is good news to collection management and development librarians. They further argue that "*in times when economic considerations influence subscription purchases and continuations, the increasingly vital role of the specialty journals narrow and developing fields requires careful vigilance medical collection selectors*" (Bierbaum & Brooks, 1995:533).

Citation- and impact-wise, the JCR indicates that journals published in Africa (or E&S Africa) have had little international impact. None of these source publications were among the top 52 journals which recorded an IF of 1.484 and above. The S AFR MED J (IF = 1.107) and the ETHIOPIAN MED J (IF = 0.174) were the only journals covered in the 2004 JCR. Whether this means that these sources are less influential is debatable. Questions that have been raised concerning the use of IFs as an indicator of journal quality may perhaps imply that small IFs do not necessarily mean little influence. What about citations from locally published sources that are not indexed in the ISI? Table 5.9 also shows that the S AFR MED J and the E AFR MED J were the most used journals by authors that published HIV/AIDS research in and about E&S Africa. The S AFR MED J was used 1804 times, while E AFR MED J was cited 876 times. These citations are only from journals that are indexed in the two citation indexes and are most probably self-citations. A study of references to these sources by locally published sources not indexed by ISI would likely produce more accurate results concerning the influence of these and many more sources published and cited locally.

In view of subject categories (or fields/disciplines) of source publications, it was observed that most sources belonged to the medical sciences category, which is not surprising since HIV/AIDS is widely perceived to be a medical problem, viz. most commonly, a sexually transmitted disease. This subject category alone accounted for about 60% of the sources in each database, which implies that most HIV/AIDS research is published in medical sources. This may be partly attributed to the fact that the cure for HIV/AIDS has remained evasive, entailing significant medical investigation (a pattern true for most human diseases). Nevertheless, the highly ranked sources from other fields/disciplines (e.g. business and economics, psychology, education, chemistry, social services and welfare, population studies, etc.) indicate that the scatter of HIV/AIDS information is not only in the form of many sources, but also sources from many different fields/disciplines, a fact which highlights the contribution of other professionals in the fight against the pandemic. With regard to the former, it is worth noting that modern methods of information storage (e.g. electronic databases that provide multiple search options) have greatly improved retrieval which would have otherwise been difficult and time consuming. Currently, one can search for information within as many databases as possible as long as the databases share a search platform, e.g. EBSCOHOST databases. Additionally, Farmer's (1999) advice to professionals from other disciplines to render discipline-specific approaches in order to understand the epidemic appears to have been heeded. A number of professionals (e.g. social workers, educationists, economists, counselors, the clergy, lawyers/advocates, library and information scientists, etc) have joined their medical counterparts in HIV/AIDS research, as illustrated in the number of non-medical source publications, an aspect also noted by Onyancha (2006). This augurs well when it comes to designing effective intervention programs. A special analysis of medical sources revealed that there were a total of 30 categories. General medical sources compiled the majority, followed by sources in communicable diseases, obstetrics and gynecology, allergology and immunology, oncology, psychiatry and neurology, and pediatrics, to mention a few. This probably implies that most research activities were carried out in order to: study the general medical aspects of HIV/AIDS; study its characteristics as a communicable disease; study its effect on pregnant mothers; and study aspects related to immunology. A subject content analysis of literature in Chapter six gives a detailed account of the subject areas of HIV/AIDS research.

A Bradford analysis was conducted in order to identify core sources of HIV/AIDS literature using both the number of papers, and citations. In the first instance, Bradford's nucleus or core sources equaled 8 in the MEDLINE database, while the ISI databases yielded 9 core sources. Most of the core sources appeared in the two databases.With the exception of one source (i.e. AIDS ANAL AFR), all core sources in the MEDLINE database were core sources in the ISI databases. There were two core sources in the ISI database (i.e. INT J TUBERC LUNG DIS and INT J STD AIDS) that did not feature amongst MEDLINE's core sources. The common core sources were AIDS, AIDS RES HUM RETROVIRUS, EAST AFR MED J, J ACQ IMMUN DEFIC SYND, J INFEC DIS, LANCET, and S AFR MED J. Citation-wise there were 13 core sources (see Table 6.13). These sources contributed 50072 citations, which accounted for 33.46% of the total number of citations (i.e. 149631). In descending order, they were AIDS, LANCET, J INFECT DIS, NEW ENGL J MED, J VIROL, J ACQ IMMUN DEF SYND, JAMA, AIDS RES HUM RETROV, SCIENCE, BRIT MED J, S AFR MED J, SOC SCI MED, and J CLIN MICROBIOL. It is worth observing that some of the core sources in the former analysis (i.e. in terms of the number of papers) appear in the latter list of core sources (i.e. using citations). However, there are a few sources that are not common to the two analyses, a situation that questions whether or not we should use the number of publications (i.e. published papers) or citations to determine core sources in a particular field/discipline.

5.6 Summary

This Chapter sought to examine the growth, productivity and scientific impact of HIV/AIDS source publications as they relate to E&S Africa. The Chapter addresses 7 research questions. Related literature was reviewed under three subheadings, namely, the rationale for evaluating source publications, methods of evaluation, and a critical examination of previously conducted informetric studies. Data was analyzed to examine the growth trends of the sources, growth of literature, geographic distribution of the source publications, the sources' productivity in terms of papers and citations, sources' influence (impact factor), the type of source publications commonly used to publish HIV/AIDS research, and the core sources of HIV/AIDS research. The following is a summary of the results:

- Despite the fact that Africa in general, and E&S Africa in particular, produces many scholarly serials, their coverage in international electronic databases is significantly less than serials published in the USA and Great Britain. The coverage of locally published HIV/AIDS sources in the MEDLINE and the ISI databases follows the same pattern. Both databases, however, yielded 1197 sources (local and foreign) that published HIV/AIDS research in and about E&S Africa. The coverage overlap was relatively high (i.e. 0.36), a situation that may complicate decision making regarding database subscription. Nevertheless, it should be borne in mind that the two databases are different in many aspects. The SCI, for instance, covers more than medical and health related topics, which are the only kind covered by MEDLINE.

- Journals are the main sources of HIV/AIDS information.
- There has been continued growth in the number of sources that publish HIV/AIDS research in and about E&S Africa, although the sources' growth rate is less than that of the papers.
- Sources that publish HIV/AIDS research in and about E&S Africa are largely published in foreign countries led by the USA, Great Britain, the Netherlands, Switzerland, Germany, and Denmark.
- Locally published sources that carry HIV/AIDS information in and about E&S Africa are few and mostly published in South Africa.
- Although foreign journals publish most HIV/AIDS papers, locally published sources still contribute a substantial amount.
- HIV/AIDS specialty journals are the most commonly used to publish HIV/AIDS papers.
- HIV/AIDS papers in and about E&S Africa are published in relatively low impact journals. Locally published sources have had little international impact.
- Medical sources are the most commonly used in publishing HIV/AIDS research in E&S Africa.
- There are about 13 core sources of HIV/AIDS research in E&S Africa, i.e. using both publications and citations counts.

It is worth noting that most HIV/AIDS research is currently published in newspapers, magazines and other similar periodicals, including the Internet – more particularly the World Wide Web. This vast array of literature could not be covered in this study due to time constraints. Also not analyzed was HIV/AIDS literature published in the form of theses and dissertations, and unpublished sources that were not covered in the three databases used to collect data (also see section 1.5). Other aspects that were not considered in the analysis of the sources of HIV/AIDS research include the sources' publication frequency, circulation, minor subject areas of coverage, publisher, and the age of the sources (when they were first published). All these factors may have influenced the productivity and scientific impact of the sources.

Chapter Six focuses on HIV/AIDS researchers (individuals, institutions & countries) and publishers of the research findings. The Chapter also provides the most cited works, most cited authors, and the patterns and trends of the growth of citations vis-à-vis that of papers.

CHAPTER SIX

PRODUCERS OF HIV/AIDS RESEARCH IN EASTERN AND SOUTHERN AFRICA

6.1 Introduction

It is readily acknowledged that research, when correctly designed and executed, builds knowledge because it represents an objective investigation of facts about a certain subject. It also presents answers to an otherwise difficult and complex topical issue, situation or phenomenon. Therefore, it is extremely important that research be evaluated in order to ascertain the extent of its impact and importance. Evaluating research is conducted to examine or describe scientific productivity and the impact of authors (individuals or group), countries (i.e. geographical locations), and/or institutions (e.g. academic, industry, etc.).

A number of governments have put in place mechanisms and systems for evaluating research performance both within and outside their territories. Donor countries are particularly keen on monitoring and evaluating research that they have funded in developing countries. This has put the funded researchers, institutions and countries under great pressure from both the donors, and the general public. In turn, countries are asking institutions that have received research funds to give an account of them, an aspect that has also affected HIV/AIDS researchers. According to Brown (1993:12), "*AIDS researchers around the world are under greater pressure than ever before to justify their existence*". This applies to institutions and countries that have received HIV/AIDS research funds. The researchers' continued funding has drawn a lot of interest from the public who question the rationale for the large sums of money channeled to AIDS research given that neither a vaccine nor cure has yet been discovered. Scientists, in turn, blame the public for its unrealistic expectations (Brown, 1993). Previous studies (e.g. The Scientist, 1999) have shown that the contribution of African authors, institutions and countries in scientific productivity and impact is low. The top ranking individuals and institutions in these studies are largely based in developed countries. Little is known about the scientific productivity and impact of African authors, institutions and countries. To the best of the researcher's knowledge, no study has been conducted to measure the performance of individual researchers, institutions and countries involved in HIV/AIDS research in and about E&S Africa. An evaluation of the performance of HIV/AIDS researchers, conducting research in and about E&S Africa, both within and outside institutions based in the region, therefore becomes important.

The purpose of this chapter was to evaluate the performance of individual authors, institutions and countries in terms of their productivity and scientific impact, the objectives being:

a. To identify the most prolific and influential researchers, countries and institutions that conduct HIV/AIDS research in and about E&S Africa; and
b. To compare the productivity and scientific impact of domestic/regional authors, institutions, and countries with those of their foreign counterparts.

The following research sub-questions were used to inform the above:

- How many countries are involved in HIV/AIDS research about E&S Africa?
- Which is/are the most productive countries (as researchers)?
- In which countries is HIV/AIDS research by and about E&S Africa mostly published?
- Which are the most prolific organizations/institutions that conduct HIV/AIDS research in and about E&S Africa?
- Who are the most productive authors of HIV/AIDS papers in and about E&S Africa?
- What is each author's scientific influence?
- Which are the most cited works?
- What are the trends and patterns of the growth of citations vis-à-vis the papers?

6.2 Evaluating authors', institutional and country research performance: an overview

Authors', institutional and country research performance evaluation is conducted for various reasons depending on the objectives of the evaluating body or person. The driving force behind most research performance evaluations, however, appears to be associated with research funding. As Geisler (2001:39) observes, "*all organizations that fund and conduct scientific research are increasingly 'under the gun' to better evaluate the performance of their programs.... they must account for their expenditures and must justify their investment decisions*". This therefore means that both parties (donors and receivers) are equally concerned with the use of research funds. Jacobs (2000) opines that research productivity studies and their accruing results enable policy makers to evaluate their decisions on the awarding of grants to individuals, institutions and even countries. The OECD (1997:5) puts it thus, "*in OECD member countries, there is an increasing emphasis on accountability, as well as on the effectiveness and efficiency of government-supported research*". The Organization further outlines some of the purposes for which governments conduct research evaluations as follows:

1. optimizing their research allocations when faced with budget stringencies;
2. re-orienting their research support;
3. rationalizing or downsizing research organizations; and
4. augmenting research productivity.

The evaluation of researchers' performance may be used to identify individuals for recruitment/employment. The most prolific individuals are more likely to secure jobs, particularly in institutions that place high regard on the researchers' productivity and scientific impact. Results from informetric evaluations of authors would therefore assist in identifying and recruiting graduate students and professors whose areas of interest and research experience complement an institution's, department's or university's focus. Many are job advertisements that emphasize authors' research productivity, aside from their academic qualification and work experience, especially on the part of universities.

The evaluation of researchers' productivity and scientific impact may also assist researchers when they attempt to identify individuals with whom they can collaborate. It may also lead to established partnerships with companies that have related research interests. Collaboration between industry and university can be improved if researchers with common interests in these institutions are identified.

Academic recruitment, promotions and tenure largely depend on an individual's research performance. Worldwide, university policies have been formulated in order to aid in proper recruitment, promotion and tenure. Although sometimes violated, these policies have to a large extent regulated how universities are run, especially with regard to recruitment and promotions. Citation analysis and impact factors are increasingly becoming yardsticks upon which faculty evaluation is based. Garfield in Popescu (2002) observes that "*the most important and recent use of impact factor is in the process of academic evaluation*". Cameron (2005) notes that the current trend involves using bibliometric data as a means of evaluating the performance of departments, institutions, and even researchers in academic institutions, a process that is now being tied to tenure and promotion. The use of citation analysis and impact factors, according to Bloch & Walter (2001), can be misconstrued. Cameron (2005) concurs with Bloch & Walter (2001) by stating that the processed data may not only mislead but also be prejudicial.

According to Lancaster (1991), evaluating individual, institutional and country productivity and impact involves: an analysis of the number of publications produced; assessing how much of the work is individual, group or organizational; and determining the quality of citations in the works published. Jacobs (2002) explains that researchers' scientific productivity is measured in terms of the researchers' published scientific output and technical output, as well as the quality of the research results. Garfield (1996) and the Organization for Economic Co-operation and Development [OECD] (1997) also identify researchers, institutions and countries as levels and entities of research performance evaluations.

Although there is general consensus regarding the need and importance of evaluating researchers (i.e. both individual and corporate), opinions are divided on how to evaluate research performance in a "*viable yet acceptable manner*" (Geisler, 2001:39). In other words, what is the most effective and appropriate research method that can be used to measure performance? Some of the mechanisms or approaches to evaluating scientific research that have been proposed by various studies include bibliometric/informetric analysis, expert review (peer-review), economic rate of return, case studies, retrospective analysis (Committee on Science, Engineering, and Public Policy [COSEPUP], 2004) and questionnaire surveys (Garfield, 1996; Jacobs, 2000). Brown (1993) identifies three main approaches to evaluating scientific productivity besides the use of opinion polls, namely, peer review, the analysis of competition for funds and citation analysis.

Arguments in favor of one or another of these approaches have lately dominated opinions in scientific literature. For instance, as recently as in 2000, Thomas J. Phelan set in motion a debate on appropriate methodologies for evaluating institutional performance (Phelan, 2000). He prefers the use of bibliometric measures (i.e. publication and citation data) to the peer-review method as a means of evaluating scientific productivity, especially when dealing with aggregated units of research. He believes that peer review, despite its long history, is, at best, extremely imperfect in evaluating a collection of works such as that produced by a department or by an individual over a career. He suggests instead the use of citation and publication analyses, which form part of the informetric/bibliometric methodologies.

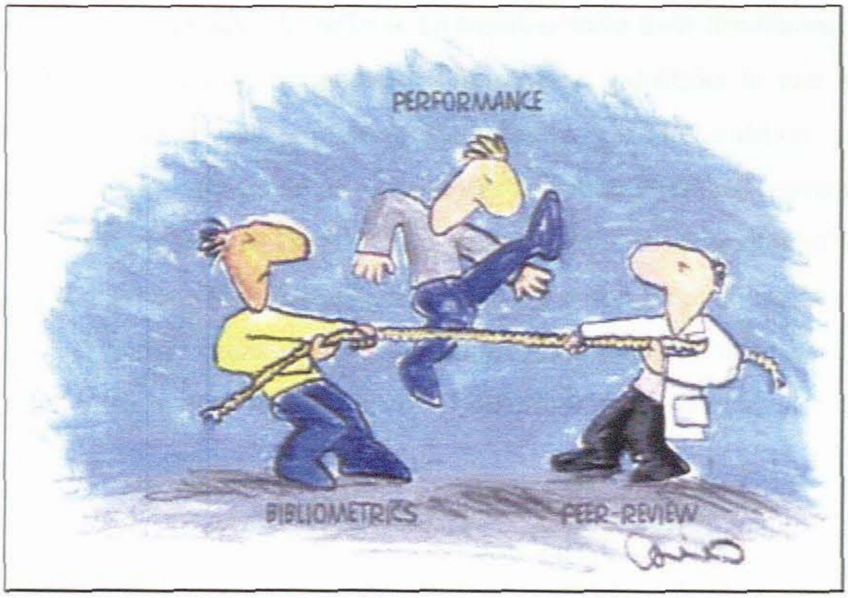


Fig. 6.1: **Bibliometrics** versus **peer-review** approaches to evaluating research **performance** (Source: Geisler, 2001:39)

Responding to Phelan's sentiments, Kostoff (2000) defends the use of peer-review, both for single and aggregated research units. He argues that other approaches to research evaluation (i.e. publications, patents, citations and other output and outcome metrics) can successfully be used to supplement but not replace peer-review. Other criticisms that have been leveled against the peer-review method include: the partiality of peers; the 'old boy' network which often results in older, entrenched fields receiving greater recognition than new, emerging areas of research; the 'halo' effect which may result in a greater likelihood of funding being made available to more visible scientists and higher status departments and institutions; reviewers often have fairly different ideas about what aspects of research they are assessing, what criteria they use and how these should be interpreted; the assumption that a high level of agreement exists among scientists about what constitutes good quality work, who is doing it and where promising lines of enquiry lie may not hold in new specialties; and resource inputs to the review process, both in terms of administrative costs and scientists' time, are considerable but ignored (King, 1987).

As in the peer-review method, bibliometric approaches have their limitations. According to Kostoff (2001), the choice of important bibliometric indicators to use for research performance measurement can prove to be problematic. In addition, controversy surrounds their use as measures of researchers', institutional and country research performance. This leads Eugene Garfield, a man credited for the founding of the Institute of Scientific Information and the development of the citation indexes extensively used in the analysis of scientific literature as a measure of research performance, to wonder whether or not bibliometric indicators really do provide the best measure (Garfield, 1989).

Elsewhere, Garfield (1996) warns that uninformed use of citation analyses as tools of decision making on funding and tenure may generate controversies. He observes that:

> *Citation analysis becomes controversial mainly when it is used as a tool in making decisions about funding or the tenure of individuals or groups, especially when it is perceived to be an uninformed use of citation data. Many of these unpublished citation analyses, like most un-refereed work, may, in fact, involve the abuse of SCI data and rightly evoke hostility or unease. After all, some highly published authors are little more than bureaucrats who attach their names to every paper they can. Unless such details are known to the evaluators, citation data could be used to perpetuate unjust distribution of resources* (Garfield, 1996: Emergence of Scientometrics section, para 2)

He nevertheless advocates the use of citation analyses in situations where research funding is highly politicized. He says:

> *But the opposite may also be true. In several countries where research funding is often highly political, many of the most deserving researchers receive a small fraction of research funds in contrast to parasites who hadn't published a paper for a decade or more. Many well-funded clinical researchers publish in obscure national journals in the local language to hide their lack of international significance. In contrast, younger researchers not only publish in the international journals but are also well cited. Their impact on their scientific fields becomes clearly visible through citation analysis* (Garfield, 1996: Emergence of Scientometrics section, para 3)

Few studies have analyzed HIV/AIDS literature in order to identify the contributing authors, institutions and countries, especially in developing countries. One such study, and perhaps the earliest that was subject-specific, is a citation analysis study that was conducted in 1996 (The Scientist, 1996) and sought to identify leading institutions and scientists in HIV/AIDS research. The study examined 34,000 research papers (only "discovery papers", i.e. original research was analyzed) from the Science Indicators database (*Science Citation Index*) and was limited to papers published between 1993 and 1995. Letters, reviews, editorials and notes were excluded. It ranked the institutions and researchers according to the total number of citations of their papers and citation impact (citations per paper). Grouping the institutions into two categories – those that produced more than 250 papers and those that produced between 100 and 249 papers each – the study identified the National Cancer Institute as the most productive, while the National Allergy and Infectious Diseases (NIAID) topped the list in the citations-per-paper category. Authors from medical institutes such as NIAID and Aaron Diamond AIDS Research Center topped the list of most cited authors. They included Anthony S. Fauci (Director of NIAID) and David Ho (Aaron Diamond AIDS Research Center) who each recorded 83 publications and 1,402 and 1,123 citations, respectively. African institutions and authors based in the continent did not feature in the study, most likely because the study presented only the institutions and authors producing 20 or more articles.

Unlike this study, the use of the MEDLINE database's AIDS-subset (AIDSLINE) to conduct informetric analyses of HIV/AIDS literature has shown that researchers and institutions in Africa actually contribute substantially to the growth and development of HIV/AIDS research. For instance, Onyancha & Ocholla's (2004b) study identified at least 6 institutions based in Kenya and Uganda that produced 20 or more papers between 1980 and 2002. These include the University of Nairobi (Kenya, 99), Kenya Medical Research Institute (KEMRI) (Kenya, 32), Makerere University (Uganda, 72), The AIDS Support Organization (TASO) (Uganda, 40), Medical Research Council (Uganda, 36) and Ministry of Health (Uganda, 33). In a study conducted by Macias-Chapula & Mijangos-Nolasco (2002) in Central Africa, the University of Kinshasa was one of the local institutions that produced more than 20 articles, having yielded 22 records.

Brown (1993:12) set out to study how well HIV/AIDS research is being 'mobilized' by investigating its quality and organization, with the intent to provide scientists with lessons about the "*best way to mobilize a large-scale research effort*". She compared the citedness (or uncitedness) of AIDS and biology papers and found a high rate of uncitedness in both subject domains. Her shock over this pattern of uncitedness and the negative reaction registered by other researchers that she interviewed is "*typical but not surprising to specialists in citation analysis*" (Garfield, 1993:325). Garfield explains this pattern by drawing the author's attention to several limitations associated with citation analysis. He observes that:

> "*No system, whether physical or natural or social, operates at 100 percent efficiency. Science publishing is no exception. So much research is being published today that there is a high probability that many papers will never be cited. And it is a certainty that most will be cited only a few times*" (Garfield, 1993:325).

Furthermore, Garfield (1993) adds that very little is known about uncitedness and what it signifies. He argues that uncitedness could be caused by any or all of the following factors: the language of publication; unavoidable and even appropriate duplication or replication; the delayed recognition of premature ideas; relative visibility of a journal or even inadequate use of information retrieval services by authors and referees; or perhaps most of the uncited literature is cited in low impact journals not covered in ISI's databases.

Two other findings in Brown's study deserve mention. Although she reported a high rate of uncitedness, she nevertheless noted a continued decline in the number of uncited papers over time. She noted that the proportion of AIDS papers published during 1987-1990 without a single citation had been markedly lower – at 11.32 percent – than that of Biology. She concluded that HIV/AIDS research had flourished, despite having also observed that interest in clinical AIDS research was on the decline.

6.3 Methods and procedures

This study focuses on three categories of entities of research performance evaluation, namely, authors, institutions and countries involved in the publication of HIV/AIDS research about E&S Africa. The use of the term "Countries" as producers of HIV/AIDS research is two-fold, i.e. countries in which HIV/AIDS research in and about E&S Africa is conducted [countries as "authors"] and countries in which the resultant HIV/AIDS research findings are published [countries as "publishers"]. Whereas the former analysis provided E&S African countries' HIV/AIDS research output, the latter analysis provided information on the countries most commonly used to publish HIV/AIDS research.

Data was extracted from the MEDLINE, Science Citation Index, and Social Sciences Citation Index databases using search terms that included terms by which HIV/AIDS was known at the beginning of the epidemic (see Tables 3.2 and 3.3 in Chapter Four).

The following techniques were used to obtain relevant data:

1. The country of journal publication was used as an indicator of the origins of the publication of HIV/AIDS research findings.
2. Institutional productivity was calculated by counting the frequencies of institutional occurrences in the authors' address field, e.g.:

   C1 KIT, Dept Biomed Res, NL-1105 AZ Amsterdam, Netherlands.
   CRDR, Kenya Med Res Inst, Nairobi, Kenya.
   KIT, Royal Trop Inst, Dept Hlth, Amsterdam, Netherlands.
   CDC, Nairobi, Kenya.
   NLTP, Minist Hlth, Nairobi, Kenya.

   The above illustration, for example, yields a total of five entries (one for each institution) Thus, each institution in this example received one posting. This counting technique was also applied to author and country productivity.
3. Two approaches were used to measure author influence:
   a. The Total Cites (TC) field of HIV/AIDS records was used to obtain the total cites that HIV/AIDS papers by E&S Africa have received in order to find out the most cited authors. Again, the complete (or normal) count technique was used to appropriate citations to authors.

b. References to HIV/AIDS papers were analyzed in order to find out the most cited authors by HIV/AIDS authors that conduct research in and about E&S Africa.

4. Geographic distribution of authors examines the author's country of origin in order to assess the most productive country or geographic region. Authors' addresses provided the authors' geographic location.
5. The Total Cites (TC) field was used to obtain the most cited HIV/AIDS papers published by and on E&S African countries. This study provided only the 'first authors' as shown in Table 7.8. 'First authors' refers to the principal authors as opposed to the first mentioned author.
6. Total author citations were obtained by adding up each author's citations using the complete count approach. Each author was awarded the whole number of citations that each record in which he/she appears has attracted. For instance, if there were n authors in record A which was cited N times, then the Total Author Cites (TAC) was calculated as follows: $TAC = n*N$, whereby each author received N number of citations.

Data was analyzed using Sitkis version 1.5 ©2005, Microsoft Office Access ©2003, Microsoft Office Excel ©2003 and Bibexcel ©2005 in order to obtain the frequencies of occurrence with regard to the following: the number of participating countries; the most productive regional and international countries and institutions; the countries in which most authors publish their research findings; the most prolific authors; highly cited works; and the average cites per paper by year of publication. Additionally, a trend analysis of the citedness of HIV/AIDS papers was performed in order to examine the trends of citedness (or uncitedness) of HIV/AIDS research.

6.4 Presentation of findings

This section provides results as follows:

- Number of countries conducting HIV/AIDS research in E&S African countries
- Most productive regional countries (as authors/researchers)

- Most productive foreign countries (as authors/researchers)
- Countries of publication (countries as publishers)
- Most productive regional institutions
- Most productive foreign institutions
- Most productive and cited authors
- Most productive and influential authors
- Most cited HIV/AIDS papers
- Patterns and trends of growth of citations and papers, 1980-2005
- Distribution of HIV/AIDS papers by the number of citations, 1980-2005

6.4.1 Number of countries conducting HIV/AIDS research on E&S African countries

Table 6.1 shows the number of countries conducting research in E&S Africa in three categories, namely, E&S African countries, countries from other regions of Africa and foreign countries. South Africa was the leading country with a total of 85 contributing countries: 13 (15.29%) from E&S Africa, 16 (18.82%) other African countries and 56 (65.88%) foreign countries. Kenya registered a total of 71 countries followed by Uganda (69), Tanzania (68), Zambia (58), Zimbabwe (56) and Malawi (51). In the bottom half of the Table are countries which had few countries that conducted HIV/AIDS research about them. These included Lesotho (18), Namibia (16), Somalia (10), Angola (9), and Eritrea (3). Every country has received interest or attention from all over the world except for Somalia, Angola and Eritrea which had no interest from African countries apart from the E&S African countries.

Table 6.1: HIV/AIDS research in E&S Africa: number of contributing countries

	E&S African countries		Rest of Africa		Foreign		TOTAL
	No. of Countries	% of Total	No. of Countries	% of Total	No. of Countries	% of Total	
South Africa	13	15.29	16	18.82	56	65.88	85
Kenya	12	16.90	13	18.31	46	64.79	71
Uganda	11	15.94	14	20.29	44	63.77	69
Tanzania	12	17.65	17	25.00	39	57.35	68
Zambia	10	17.24	13	22.41	35	60.34	58
Zimbabwe	13	23.21	12	21.43	31	55.36	56
Malawi	12	23.53	8	15.69	31	60.78	51
Ethiopia	10	26.32	3	7.89	25	65.79	38
Botswana	11	35.48	2	6.45	18	58.06	31
Mozambique	6	26.09	1	4.35	16	69.57	23
Swaziland	8	36.36	1	4.55	13	59.09	22
Sudan	4	20.00	2	10.00	14	70.00	20
Lesotho	7	38.89	2	11.11	9	50.00	18
Djibouti	3	18.75	5	31.25	8	50.00	16
Namibia	7	43.75	1	6.25	8	50.00	16
Somalia	2	20.00	0	0.00	8	80.00	10
Angola	2	22.22	0	0.00	7	77.78	9
Eritrea	2	66.67	0	0.00	1	33.33	3

6.4.2 Most productive regional countries (as researchers)

Productivity by regional countries yielded a total of 43 African countries (illustrated in column 1) that conducted HIV/AIDS research about E&S African countries, implying therefore that only 10 (18.87%) independent countries from the continent did not participate in HIV/AIDS research about the two regions. Table 6.2 provides countries that authored 12 or more papers about E&S African countries as indexed in the ISI indexes. South Africa led with a total of 2189 papers distributed, in descending order, as follows: South Africa (1929), Zimbabwe (43), Tanzania (42), Uganda (39), Kenya (29), and so on. In second position was Kenya which posted a total of 843 records, 714 of which were produced by Kenya. Kenya's other highest productivity was on Tanzania and Uganda which yielded 30 papers each. Other regional countries that conducted research in and about E&S African countries include Uganda (717), Tanzania (540), Malawi (487), Zambia (407), and Zimbabwe (400), etc.

Contributing country (Researcher)	ANG	BW	DJ	ER	ETH	KE	LE	MAL	MOZ	NAM	SOM	S. AFR	SUD	SW	TZ	UG	ZAM	ZIM	TOTAL
	Country of research focus (Researched)																		
SOUTH AFRICA	1	13	2	1	6	29	10	19	8	7	1	1929	3	10	42	39	26	43	2189
KENYA	0	2	0	0	2	714	0	13	1	0	0	24	1	0	30	30	20	6	843
UGANDA	0	1	0	0	3	22	0	9	1	0	0	21	0	0	36	599	15	10	717
TANZANIA	0	0	0	0	3	20	0	4	1	0	0	12	0	2	436	47	7	8	540
MALAWI	0	1	0	0	1	21	1	379	2	1	0	24	0	2	16	16	10	13	487
ZAMBIA	0	4	0	0	0	20	0	6	0	0	0	20	0	0	11	17	314	15	407
ZIMBABWE	0	4	0	0	2	10	1	8	0	1	0	35	0	2	10	23	15	289	400
ETHIOPIA	0	2	1	0	205	4	0	3	0	0	0	2	2	0	11	8	2	3	243
BOISIWANA	0	74	0	0	2	2	4	2	0	1	0	10	0	8	3	1	1	1	109
CAMEROON	0	0	3	0	1	10	0	2	0	0	0	1	0	0	7	9	8	1	42
MOZAMBIQUE	0	0	0	0	0	1	0	2	26	0	0	3	0	1	1	1	1	0	36
EGYPT	0	0	11	0	0	4	0	0	0	0	2	1	6	0	0	4	1	1	30
SWAZILAND	0	4	0	0	0	0	5	2	0	1	0	6	0	9	1	0	0	2	30
NIGERIA	0	2	0	0	0	2	0	0	1	1	0	13	0	0	1	1	2	4	27
ZAIRE	0	0	1	0	0	10	0	0	0	0	0	1	0	0	2	6	6	1	27
SUDAN	0	0	0	0	1	1	0	0	0	0	0	0	22	0	0	2	0	0	26
RWANDA	0	1	0	0	0	4	0	4	0	0	0	1	0	0	2	7	4	1	24
NAMIBIA	0	1	0	0	0	0	1	1	0	13	0	2	0	1	2	0	0	1	22
BURKINA FASO	0	0	0	0	6	0	1	0	0	0	5	0	0	0	5	0	1	3	21
LESOTHO	0	3	0	0	0	0	7	0	0	1	0	5	0	4	0	0	0	1	21
GAMBIA	0	0	0	0	0	4	0	3	0	0	0	3	0	0	3	5	2	0	20
SENEGAL	0	0	1	0	0	4	0	1	0	0	0	3	0	0	3	3	2	0	17
GHANA	0	0	0	0	0	6	0	0	0	0	0	3	0	0	1	3	0	2	15
BENIN	0	0	0	0	0	5	0	0	0	0	0	2	0	0	2	0	4	0	13
CENT AFR REPUBL	0	0	0	0	1	2	0	3	0	0	0	1	0	0	0	5	0	0	12

Table 6.2: Most productive regional countries (Researchers)

6.4.3 Most productive foreign countries (as Researchers)

In the foreign countries category, a total of 77 countries produced papers on HIV/AIDS in E&S Africa. The USA was the most prolific with a total of 2429 papers in the ISI databases. Her highest contribution was on South Africa (536) followed by Uganda (505), Kenya (407), Tanzania (288), Zambia (180) and Zimbabwe (157), etc. Second was England which produced a total of 1412 papers, including 309 on South Africa, 261 on Uganda, 192 on Kenya, 186 on Tanzania, 173 on Zambia, and 156 on Malawi, etc. Switzerland, which held the third position, had 365 papers which were distributed as follows: 65 papers each for South Africa and Uganda, while Kenya's and Tanzania's share was 57 and 45 papers, respectively. Other countries that produced a relatively large number of papers on E&S Africa were the Netherlands (349), Canada (336), France (279), Belgium (279), Sweden (246), Germany (173), Norway, (121), Australia (108), and Thailand (101), etc. The least productive foreign countries were Kuwait, Latvia, Lithuania, Martinique, Myanmar, Philippines, Saudi Arabia, Sri Lanka, and Tajikstan, which produced one paper each.

6.4.4 Distribution of Records by Countries of Publication (countries as publishers)

The country of publication for HIV/AIDS papers was included in the analysis in order to identify countries in which HIV/AIDS research is published and disseminated. Table 6.4 identifies a total of 51 such countries. In descending order of the overall rank, the USA published the largest number of papers in both databases (i.e. MEDLINE 2209, ISI 2679). Great Britain was in 2nd position with 2123 papers in the MEDLINE and 2116 papers in ISI databases, followed by South Africa [in the order of MEDLINE, ISI] (609, 560), France (122, 213), Kenya (168, 163), Canada (199, 27), the Netherlands (124, 99), Switzerland (105, 96), Denmark (66, 60), and Zimbabwe (107, 18), etc. Other African countries that published HIV/AIDS papers originating from and about E&S African countries include Ethiopia (43, 60), Nigeria (21, 0), Malawi (6, 0), Egypt (4, 0), and Uganda (1, 0).

Contributing country (Researcher)	Country of research focus (Researched)																		
	ANG	***BW***	***DJ***	***ER***	***ETH***	***KE***	***LE***	***MAL***	***MOZ***	***NAM***	***SOM***	***S. AFR***	***SUD***	***SW***	***TZ***	***UG***	***ZAM***	***ZIM***	***TOTAL***
USA	1	66	14	0	28	407	6	187	16	5	5	536	18	10	288	505	180	157	2429
ENGLAND	0	10	0	0	19	192	2	156	7	4	0	309	6	6	186	261	173	81	1412
SWITZERLAND	0	8	1	0	10	57	1	43	3	2	1	65	3	4	45	65	32	25	365
NETHERLANDS	0	4	0	0	69	49	0	34	2	1	1	47	4	2	67	41	11	17	349
CANADA	0	9	0	0	7	172	0	9	2	0	0	53	0	0	20	36	7	21	336
FRANCE	2	0	4	0	16	30	0	17	3	0	0	73	5	0	38	62	11	18	279
BELGIUM	0	0	2	0	6	83	0	11	2	1	1	40	0	2	35	27	26	10	246
SWEDEN	3	2	1	3	47	21	0	3	8	0	0	10	1	0	76	30	15	15	235
GERMANY	1	0	0	0	3	13	0	6	1	6	0	44	1	9	35	47	1	6	173
NORWAY	0	4	0	0	14	4	0	4	6	0	1	8	3	1	42	17	7	10	121
AUSTRALIA	0	0	0	0	0	10	0	14	2	0	0	53	0	0	6	12	6	5	108
THAILAND	0	3	0	0	2	18	0	7	0	0	0	22	0	0	11	22	4	12	101
ITALY	1	1	0	0	2	16	0	1	3	0	2	17	2	0	5	35	6	5	96
DENMARK	0	1	0	0	5	15	0	2	0	0	0	3	0	0	29	4	6	17	82
SCOTLAND	0	0	0	0	1	5	0	1	0	0	0	12	0	0	8	24	10	4	65
BRAZIL	0	1	0	0	1	10	0	3	1	0	0	21	0	0	3	16	2	3	61
ISRAEL	0	4	0	0	22	1	0	2	0	0	0	20	1	0	1	2	3	1	57
INDIA	0	4	0	0	1	4	0	5	0	0	0	10	1	0	9	14	2	5	55
JAPAN	0	2	2	0	2	11	0	1	0	1	0	7	0	0	5	7	9	1	48
SPAIN	1	1	0	0	0	3	1	1	3	0	0	16	0	1	3	14	4	0	48
FINLAND	0	0	1	0	5	6	0	6	0	1	0	2	0	0	4	3	3	2	33
IRELAND	0	0	0	0	2	7	0	1	0	0	0	4	0	0	2	3	0	1	20
LUXEMBOURG	0	0	0	0	0	3	0	13	0	0	0	1	0	0	0	2	0	0	19
ARGENTINA	0	0	0	0	0	1	0	0	0	0	0	11	0	0	1	3	2	0	18
MEXICO	0	1	0	0	2	1	0	0	0	0	0	6	1	0	1	4	1	1	18
PEOPLES R CHINA	0	1	0	0	0	3	1	0	0	0	0	9	0	1	2	0	0	0	17
WALES	0	0	0	0	0	3	0	4	0	0	0	6	0	0	1	0	2	0	16
PERU	0	0	0	0	0	2	1	0	0	0	0	4	0	1	3	2	2	0	15

Table 6.3: Most productive foreign countries (Researchers)

Table 6.4: Distribution of Articles by country of publication (Publishers)

		MEDLINE (N=6178)			ISI (N=6367)		
	Country	*Rank*	*Papers*	*%*	*Rank*	*Papers*	*%*
1	USA	1	2209	35.76	1	2679	43.36
2	Great Britain	2	2123	34.36	2	2116	33.23
3	South Africa	3	609	9.86	3	560	8.80
4	France	7	122	1.97	4	213	3.45
5	Kenya	5	168	2.72	5	163	2.64
6	Canada	4	199	3.22	11	27	0.44
7	Netherlands	6	124	2.01	6	99	1.60
8	Switzerland	9	105	1.70	7	96	1.55
9	Denmark	10	66	1.07	9	60	0.97
10	Zimbabwe	8	107	1.73	12	18	0.29
11	Germany	11	47	0.76	8	67	1.08
12	Ethiopia	13	43	0.70	9	60	0.97
13	Norway	12	45	0.73	10	52	0.84
14	Ireland	14	34	0.55	10	52	0.84
15	Australia	16	17	0.28	15	8	0.13
16	Nigeria	15	21	0.34	22		0.00
17	Israel	18	13	0.21	16	7	0.11
18	Japan	17	14	0.23	18	5	0.08
19	Italy	19	11	0.18	15	8	0.13
20	India	22	7	0.11	14	10	0.16
21	Spain	21	8	0.13	16	7	0.11
22	Bangladesh	21	8	0.13	16	7	0.11
23	Austria	22	7	0.11	17	6	0.10
24	New Zealand	27	1	0.02	13	11	0.18
25	Russia	20	9	0.15	20	2	0.03
26	Greece	26	2	0.03	16	7	0.11
27	Sweden	22	7	0.11	22		0.00
28	Malawi	23	6	0.10	22		0.00
29	Brazil	24	4	0.06	20	2	0.03
30	Turkey	26	2	0.03	19	3	0.05
31	Egypt	24	4	0.06	22		0.00
32	Belgium	25	3	0.05	21	1	0.02
33	Slovakia	26	2	0.03	20	2	0.03
34	Poland	27	1	0.02	19	3	0.05
35	China	27	1	0.02	19	3	0.05
36	Papua New Guinea	26	2	0.03	21	1	0.02
37	Ukraine	26	2	0.03	22		0.00
38	Singapore	27	1	0.02	21	1	0.02
39	Finland	27	1	0.02	21	1	0.02
40	Saudi Arabia	28		0.00	20	2	0.03
41	Uganda	27	1	0.02	22		0.00
42	New Caledonia	27	1	0.02	22		0.00
43	Hungary	27	1	0.02	22		0.00
44	Hong Kong	27	1	0.02	22		0.00
45	Czech Rep	27	1	0.02	22		0.00
46	Chile	27	1	0.02	22		0.00
47	Venezuela	28		0.00	21	1	0.02
48	U Arab Emirates	28		0.00	21	1	0.02
49	Mexico	28		0.00	21	1	0.02
50	Korea	28		0.00	21	1	0.02
51	Croatia	28		0.00	21	1	0.02
	TOTAL		6161	99.72		6364	99.95

Note: 17 papers in Medline and 3 papers in ISI were excluded from the analysis for lack of data

6.4.5 Most productive regional institutions

Only data that was collected from the ISI databases was analyzed to obtain the most prolific regional institutions in terms of the number of publications each institution produced. A total of 36 institutions produced 18 or more papers as shown in Table 6.5. The University of Witwatersrand was the most productive, with a total of 460 papers, followed by the University of Nairobi (425), University of KwaZulu Natal [including University of Natal] (381), University of Cape Town (331), Makerere University (287), and the University of Zimbabwe (237). In positions 7 and 8 were non-academic institutions, namely, the Ministry(ies) of Health and Uganda Virus Research Institute, which produced a total of 206 and 196 papers, respectively. Others in this category include the Kenya Government Medical Research Center (160), Kenya Medical Research Institute (103), the South African Institute for Medical Research (94), and the National Institute of Virology (81). A further category that featured in the top 36 institutions was the hospitals which included Baragwanath Hospital (75), Muhimbili Medical Center (74), Coast Provincial General Hospital (43), Mulago Hospital (42), Tygerberg Hospital (42), Hlabisa Hospital (32), and the Jomo Kenyatta National Hospital (20). At the bottom of the Table are four institutions which were among the first to author HIV/AIDS papers, but afterwards appeared to disappear from the scene. These are Somerset Hospital (9), Groote Schuur Hospital (4), HF Verwoerd Hospital (4), and the Red Cross War Memorial Childrens Hospital (4), all of which are located in South Africa.

Table 6.5: Most productive regional institutions

NO.	*RANK*	*INSTITUTION*	*1981-1985*	*1986-1990*	*1991-1995*	*1996-2000*	*2001-2005*	*TOTAL*
1	1	UNIV WITWATERSRAND	1	28	61	120	250	460
2	2	UNIV NAIROBI	-	35	105	132	153	425
3	3	UNIV KWAZULU NATAL (UNIV NATAL)	-	7	32	119	230	381
4	4	UNIV CAPE TOWN	4	5	27	78	217	331
5	5	MAKERERE UNIV	-	7	51	88	148	287
6	6	UNIV ZIMBABWE	-	11	59	58	109	237
7	7	MINIST HLTH	-	9	47	63	87	206
8	8	UGANDA VIRUS RES INST	-	-	22	57	117	196
9	9	UNIV STELLENBOSCH	2	5	11	43	104	165
10	10	KENYA GOVT MED RES CTR	-	14	59	21	66	160
11	11	UNIV MALAWI	-	-	12	48	89	149
12	12	MUHIMBILI UNIV	-	-	20	55	73	148
13	13	UNIV ZAMBIA	-	13	45	27	61	146
14	14	UNIV ADDIS ABABA	-	5	24	28	47	104
15	15	KENYA MED RES INST	-	9	59	25	10	103
16	16	UNIV TEACHING HOSP	-	6	11	29	55	95
17	17	S AFRICAN INST MED RES	2	11	15	45	21	94
18	18	UNIV PRETORIA	4	-	10	20	51	85
19	19	NATL INST VIROL	-	8	24	31	26	81
20	20	BARAGWANATH HOSP	-	-	12	15	48	75
21	21	MUHIMBILI MED CTR	-	9	33	22	10	74
22	22	ETHIOPIAN HLTH & NUTR RES INST	-	-	-	18	37	55
23	23	UNIV DAR ES SALAAM	-	5	12	21	15	53
24	24	S AFRICAN MRC	-	-	12	12	24	48
25	25	AFRICAN MED & RES FDN	-	-	10	20	17	47
26	25	UNIV LUSAKA	-	-	16	23	8	47
27	26	COAST PROV GEN HOSP	-	-		17	26	43
28	27	MULAGO HOSP	-	3	9	12	18	42
29	27	TYGERBERG HOSP	2	-	9	17	15	42
30	28	BUGANDO MED CTR	-	-	18	11	7	36
31	29	HLABISA HOSP	-	-	-	24	8	32
32	30	UNIV ORANGE FREE STATE	-	-	-	12	18	30
33	31	KENYATTA NATL HOSP	-	-	13	-	7	20
34	31	KILIMANJARO CHRISTIAN MED CTR	-	-	-	13	7	20
35	32	UGANDA CANC INST	-	-	-	12	7	19
36	33	KING EDWARD VIII HOSP	-	9	9	-	-	18
		SOMERSET HOSP	2	-	-	-	7	9
		GROOTE SCHUUR HOSP	1	3	-	-	-	4
		RED CROSS WAR MEM CHILDRENS HOSP	1	-	-	-	3	4
		HF VERWOERD HOSP	3	-	-	-	-	3

Table 6.6: Most productive foreign institutions

NO.	RANK	INSTITUTION	1986-1990	1991-1995	1996-2000	2001-2005	TOTAL
1	1	CTR DIS CONTROL & PREVENTION	3	31	82	136	252
2	2	JOHNS HOPKINS UNIV	4	26	69	142	241
3	3	LONDON SCH HYG & TROP MED	6	11	73	146	236
4	4	WHO	4	34	50	119	207
5	5	UNIV WASHINGTON	8	31	50	117	206
6	6	HARVARD UNIV	-	17	36	131	184
7	7	UNIV MANITOBA	22	58	50	45	175
8	8	COLUMBIA UNIV	-	8	39	112	159
9	8	UNIV LIVERPOOL	-	9	59	91	159
10	9	CASE WESTERN RESERVE UNIV	3	20	52	52	127
11	10	KAROLINSKA INST	-	31	38	55	124
12	11	UNIV CALIF SAN FRANCISCO	-	15	35	69	119
13	12	UNIV OXFORD	-	5	38	69	112
14	13	UNIV AMSTERDAM	-	17	28	61	106
15	14	INST TROP MED	4	31	22	41	98
16	15	UNIV N CAROLINA	-	5	21	70	96
17	16	FRED HUTCHINSON CANC RES CTR	-	3	9	66	78
18	17	UNIV ALABAMA	-	11	14	49	74
19	18	NIAID	4	15	16	38	73
20	19	STANFORD UNIV	-	11	21	35	67
21	19	UNIV COLL LONDON	-	4	19	44	67
22	20	BLOOD TRANSFUS SERV	5	53	3	4	65
23	20	FAMILY HLTH INT	-	5	21	39	65
24	21	NCI	5	22	20	10	57
25	22	COLL MED	-	-	33	21	54
26	22	UNIV BERGEN	-	13	18	23	54
27	23	IMPERIAL COLL SCI TECHNOL & MED	-	-	9	40	49
28	24	DUKE UNIV	-	7	11	25	43
29	25	EMORY UNIV	-	6	10	26	42
30	26	INST PASTEUR	-	8	10	23	41
31	27	UNIV TORONTO	-	-	12	28	40
32	28	STATE UNIV GHENT	-	3	11	23	37
33	28	SWEDISH INST INFECT DIS CONTROL	-	11	16	10	37
34	29	UNIV TEXAS	-	15	11	10	36
35	30	ROYAL TROP INST	-	16	15	4	35
36	31	UNAIDS	-	-	8	25	33
37	32	ST MARYS HOSP	-	14	7	10	31
38	32	UNIV HOSP CLEVELAND	-	3	15	13	31

6.4.6 Most productive foreign institutions

Table 6.6 provides the 38 most productive foreign institutions. Only one foreign institute was involved in the authorship of HIV/AIDS papers before 1986, notably WEIZMANN INST SCI (Israel). The entry of foreign institutions/organizations into the authorship of AIDS papers about E&S Africa appears to have occurred in the late 1980s. The period witnessed a large number of papers being authored by the University of Manitoba (Canada), which contributed 22 papers between 1986 and 1990, followed by the University of Washington (8) and the University of London's SCH HYG & TROP MED (6). Thereafter, more and more institutions became involved in the production of

HIV/AIDS papers in the region, as illustrated by the growth of papers and institutions in subsequent years. Overall, the CTR DIS CONTROL & PREVENTION was the most productive with 252 papers, followed by JOHNS HOPKINS UNIV (241), LONDON SCH HYG & TROP MED (236), the WHO (207), UNIV WASHINGTON (206), HARVARD UNIV (184), UNIV MANITOBA (175), and COLUMBIA UNIV (159), etc.

6.4.7 Most productive authors

Table 6.7 shows how the most productive authors have also been cited. References in E&S Africa HIV/AIDS papers (column 4 of the Heading Row) provide the most used or referred to authors by authors of HIV/AIDS papers on E&S African countries. Ranked in terms of the number of publications, in the order of ISI then MEDLINE, is Plummer FA (ISI 147, MEDLINE 106) followed by Ndinya-Achola JO (141, 99), Kreiss JK (116, 68), Whitworth JAG (111, 100), Bwayo JJ (108, 94), and Harries AD (102, 47), etc. Citation-wise, column 4 shows that whereas Plummer FA was the most productive author, he ranked 7th as the most cited author by HIV/AIDS authors in the region. He received 285 cites in total. The top ranked author was Wilkinson D, who was cited 462 times, followed by Grosskurth H (428), Harries AD (381), Gilks CF (359), Wawer MJ (355), Coutsoudis A (299), Fawzi WW (263), Taha TET (250), and Temmerman M (244). Column 5 [when counted using the first row] provides the total author cites (TAC) – cumulative cites for each author – received by the authors from the total HIV/AIDS papers they have published in and on E&S African countries. The cumulative author cites were 614452. The topmost ranked was Plummer FA whose 147 papers in ISI have been cited 6639 times, accounting for 1.08% of the total cites, followed by Ndinya-Achola JO (5909, 0.96%), Kreiss JK (4093, 0.67%), Bwayo JJ (3734, 0.61%), Hayes RJ (3228, 0.53%), Miotti PG (2205, 0.36%), Wawer MJ (2171, 0.35%), Sewankambo NK (2162, 0.35%), Serwadda D (2090, 0.34%), and Gray RH (2086, 0.34%), etc. The distribution of the citations by the average cites per paper was as follows, in descending order: Plummer FA (45.16), Miotti PG (45.00), Wawire-Mangen F (42.83), Ndinya-Achola JO (41.91), Grosskurth H (41.49), Kreiss JK (35.28), Wawer MJ (35.02), Bwayo JJ (34.57), Sewankambo NK (34.32) and Hayes RJ (33.98).

Table 6.7: Most productive authors: ranked by the total number of publications in the ISI's Science Indicators

	ISI (N=6336)		MEDLINE (N=5708)		References in E&SA AIDS papers	Total Author Cites (N=614452)		Av. Cites per paper (x/y)
	Papers [y]	*%*	*Papers*	*%*		*Cites [x]*	*%*	
PLUMMER, FA	147	2.32	106	1.86	285	6639	1.08	45.16
NDINYA-ACHOLA, JO	141	2.23	99	1.73	27	5909	0.96	41.91
KREISS, JK	116	1.83	68	1.19	228	4093	0.67	35.28
WHITWORTH, JAG	111	1.75	100	1.75	46	1456	0.24	13.12
BWAYO, JJ	108	1.70	94	1.65	59	3734	0.61	34.57
HARRIES, AD	102	1.61	47	0.82	381	759	0.12	7.44
COOVADIA, HM	98	1.55	70	1.23	36	1425	0.23	14.54
HAYES, RJ	95	1.50	63	1.10	125	3228	0.53	33.98
GILKS, CF	87	1.37	62	1.09	359	1841	0.30	21.16
SERWADDA, D	67	1.06	67	1.17	240	2090	0.34	31.19
MANDALIYA, K	67	1.06	41	0.72	-	1146	0.19	17.10
WILKINSON, D	67	1.06	41	0.72	462	1022	0.17	15.25
FAWZI, WW	66	1.04	43	0.75	263	691	0.11	10.47
GRAY, RH	65	1.03	67	1.17	190	2086	0.34	32.09
SEWANKAMBO, NK	63	0.99	67	1.17	167	2162	0.35	34.32
WAWER, MJ	62	0.98	60	1.05	355	2171	0.35	35.02
RICHARDSON, BA	62	0.98	39	0.68	14	1325	0.22	21.37
SALANIPONI, FML	61	0.96	29	0.51	15	448	0.07	7.34
OVERBAUGH, J	57	0.90	29	0.51	32	1563	0.25	27.42
KARIM, SSA	56	0.88	50	0.88	60	630	0.10	11.25
MOODLEY, J	56	0.88	30	0.53	13	438	0.07	7.82
MSAMANGA, GI	55	0.87	38	0.67	8	577	0.09	10.49
TAHA, TET	55	0.87	43	0.75	250	1234	0.20	22.44
WOOD, R	54	0.85	39	0.68	29	650	0.11	12.04
BIBERFELD, G	53	0.84	46	0.81	11	713	0.12	13.45
FONTANET, AL	52	0.82	40	0.70	90	560	0.09	10.77
COUISIOUDIS, A	52	0.82	35	0.61	299	851	0.14	16.37
JACKSON, JB	51	0.80	34	0.60	86	1329	0.22	26.06
BROADHEAD, RL	51	0.80	41	0.72	2	1015	0.17	19.90
MMIRO, F	51	0.80	29	0.51	7	1370	0.22	26.86
MUGERWA, RD	49	0.77	31	0.54	17	1055	0.17	21.53
MIOTTI, PG	49	0.77	33	0.58	133	2205	0.36	45.00
WOLDAY, D	48	0.76	43	0.75	43	248	0.04	5.17
MORRIS, L	47	0.74	38	0.67	47	461	0.08	9.81
GROSSKURTH, H	47	0.74	36	0.63	428	1950	0.32	41.49
TEMMERMAN, M	47	0.74	33	0.58	244	800	0.13	17.02
HUNTER, DJ	47	0.74	32	0.56	52	823	0.13	17.51
CHINTU, C	46	0.73	43	0.75	140	554	0.09	12.04
ESSEX, M	45	0.71	26	0.46	32	751	0.12	16.69
ELLNER, JJ	45	0.71	19	0.33	14	1014	0.17	22.53
MOSES, S	44	0.69	34	0.60	217	1167	0.19	26.52
KALEEBU, P	43	0.68	26	0.46	70	1200	0.20	27.91
KATZENSTEIN, DA	42	0.66	38	0.67	39	649	0.11	15.45
WHALEN, CC	42	0.66	24	0.42	130	529	0.09	12.60
WILLIAMS, BG	42	0.66	27	0.47	142	628	0.10	14.95
GUAY, LA	42	0.66	26	0.46	215	1173	0.19	27.93
DE WIT, TFR	42	0.66	36	0.63	5	610	0.10	14.52
MASON, PR	42	0.66	28	0.49	31	442	0.07	10.52
KUMWENDA, NI	41	0.65	36	0.63	14	411	0.07	10.02
MESSELE, T	40	0.63	33	0.58	-	344	0.06	8.60
WABWIRE-MANGEN, F	40	0.63	38	0.67	27	1713	0.28	42.83
MHALU, FS	39	0.62	54	0.95	74	696	0.11	17.85
KUHN, L	39	0.62	28	0.49	94	715	0.12	18.33
GLYNN, JR	39	0.62	28	0.49	1	523	0.09	13.41
SPIEGELMAN, D	38	0.60	24	0.42	-	504	0.08	13.26
LAVREYS, L	38	0.60	25	0.44	34	529	0.09	13.92

Table 6.8: Most cited works: ranked by total cites

No.	No. of authors	First Author	Country of Research	Journal	Publication Year	Volume	Issue	Total Cites	Co-Authorship Type
1	14	GROSSKURTH H	TANZANIA	LANCET	1995	346	8974	740	INTERNATIONAL
2	19	GUAY LA	UGANDA	LANCET	1999	354	9181	519	INTERNATIONAL
3	11	CAMERON DW	KENYA	LANCET	1989	2	8660	477	INTERNATIONAL
4	9	QUINN TC	UGANDA	N ENGL J MED	2000	342	13	471	INTERNATIONAL
5	11	PLUMMER FA	KENYA	J INFEC DIS	1991	163	2	451	INTERNATIONAL
6	2	FLEMING DT	TANZANIA	SEX TRANSM INFECT	1999	75	1	394	FOREIGN
7	17	SIMPSON GR	UGANDA	LANCET	1996	348	9035	392	FOREIGN
8	10	SIMONSEN JN	KENYA	N ENGL J MED	1988	319	5	340	INTERNATIONAL
9	11	GREENBLATT RM	KENYA	AIDS	1988	2	1	281	INTERNATIONAL
10	18	LUCAS SB	UGANDA	AIDS	1993	7	12	273	FOREIGN
11	20	COHEN MS	MALAWI	LANCET	1997	349	9069	272	INTERNATIONAL
12	8	GURTLER LG	UGANDA	J VIROL	1994	68	3	258	FOREIGN
13	15	WAWER MJ	UGANDA	LANCET	1999	353	9152	245	INTERNATIONAL
14	13	KREISS J	KENYA	JAMA	2000	283	9	235	INTERNATIONAL
15	11	NDUATI R	KENYA	JAMA	1992	268	4	235	INTERNATIONAL
16	7	SEMBA RD	MALAWI	LANCET	1994	343	8913	222	INTERNATIONAL
17	14	ROWLAND-JONES SL	KENYA	J CLIN INVEST	1998	102	9	212	INTERNATIONAL
18	5	VANSOOLINGEN D	ETHIOPIA	J CLIN MICROBIOL	1993	31	8	211	INTERNATIONAL
19	10	ELLIOTT AM	ZAMBIA	BRIT MED J	1990	301	6749	201	INTERNATIONAL
20	12	GILKS CF	KENYA	LANCET	1990	336	8714	200	INTERNATIONAL
21	11	GAO F	UGANDA	J VIROL	1996	70	10	198	FOREIGN
22	8	VAN RIE A	SOUTH AFRICA	N ENGL J MED	1999	341	16	177	INTERNATIONAL
23	10	GRAY CM	SOUTH AFRICA	LANCET	1997	350	9077	171	INTERNATIONAL
24	14	SEWANKAMBO N	UGANDA	J IMMUNOL	1999	162	3	171	INTERNATIONAL
25	7	CORBETT EL	SOUTH AFRICA	ARCH INTERN MED	2003	163	9	170	INTERNATIONAL

6.4.8 Most Cited Works

Table 6.8 provides 25 of the most cited works. At the top of the Table is a paper written by Grosskurth H and others which received 740 citations. The paper was published in the *LANCET* of 1995 and its country of research was Tanzania. The 'country of research' refers to either the country in which research was conducted (country as researcher) or the country of research focus (researched country). Second was a paper published in the *LANCET* in 1999 by Guy LA and 18 other authors. This paper, whose country of focus was Uganda, was cited 519 times. Other 'first authors' whose works featured in the top 25 most cited include Cameron DW and others who received 477 citations, Quinn TC et al. (471), Plummer FA et al. (451), Fleming DT (394), and Simpson GR et al. (392) etc. Other notable observations that can be made include the following: out of the 25 most cited works, 19 were internationally co-authored and 6 foreign authored; all were published in high impact factor (IF) journals led by the LANCET (9), NEW ENGL J MED (3), and *AIDS* and *JAMA,* which produced two papers each; countries of research comprised of Kenya and Uganda, which yielded 8 highly cited papers followed by South Africa (3), Malawi and Tanzania which yielded 2 papers each, and Ethiopia and Zambia which produced one article each; all the works were authored by more than two authors, i.e., between 2 and 20 authors; and all, except two papers, were published between 1990 and 2003, the earliest being a 1988 publication, and the latest published in 2003.

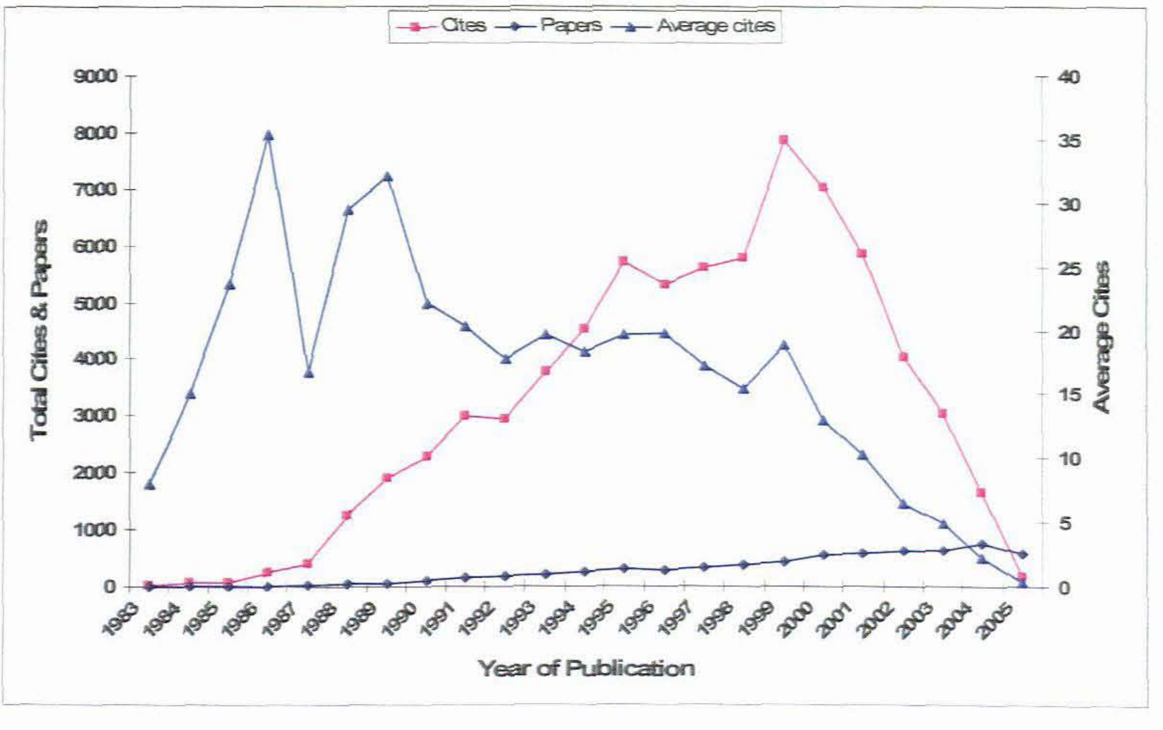
6.4.9 Patterns and trends of growth of citations and papers, 1980-2005

An analysis of the citations received by HIV/AIDS papers shows remarkable growth, as illustrated in Table 6.9 and Fig 6.2. From just 24 citations from 3 papers in 1983, the number of citations increased to 72450 from 6367 papers, thus creating 0.31 average citations per paper. Except for a few instances, the growth of citations was observed throughout the entire period of study, with 1999 registering the highest number. Negative growth rates were witnessed in 1992, 1996, and 2000 and beyond. Comparatively, HIV/AIDS papers have shown an upward trend throughout the study period except for 1996, 2003 and 2005, when the number of papers decreased slightly.

Table 6.9: Growth of citations vis-à-vis the papers, 1980-2005

Year	Total Cites	Change in %	Cumulative Cites	Change in %	Papers	% of Total Papers	Cumulative Papers	Change in %	Average cites per paper
2005	182	-88.98	72450	0.25	581	9.13	6367	10.04	0.31
2004	1652	-45.53	72268	2.34	741	11.64	5786	14.69	2.23
2003	3033	-25.04	70616	4.49	626	9.83	5045	14.17	4.85
2002	4046	-30.75	67583	6.37	628	9.86	4419	16.57	6.44
2001	5843	-16.85	63537	10.13	571	8.97	3791	17.73	10.23
2000	7027	-10.69	57694	13.87	545	8.56	3220	20.37	12.89
1999	7868	36.50	50667	18.38	416	6.53	2675	18.42	18.91
1998	5764	3.30	42799	15.56	374	5.87	2259	19.84	15.41
1997	5580	5.38	37035	17.74	325	5.10	1885	20.83	17.17
1996	5295	-7.02	31455	20.24	269	4.22	1560	20.84	19.68
1995	5695	25.86	26160	27.83	291	4.57	1291	29.10	19.57
1994	4525	20.31	20465	28.39	247	3.88	1000	32.80	18.32
1993	3761	28.23	15940	30.88	192	3.02	753	34.22	19.59
1992	2933	-2.04	12179	31.72	166	2.61	561	42.03	17.67
1991	2994	31.84	9246	47.89	148	2.32	395	59.92	20.23
1990	2271	19.78	6252	57.05	103	1.62	247	71.53	22.05
1989	1896	49.76	3981	90.94	59	0.93	144	69.41	32.14
1988	1266	214.93	2085	154.58	43	0.68	85	102.38	29.44
1987	402	62.75	819	96.40	24	0.38	42	133.33	16.75
1986	247	247.89	417	145.29	7	0.11	18	63.64	35.29
1985	71	-5.33	170	71.72	3	0.05	11	37.50	23.67
1984	75	212.50	99	312.50	5	0.08	8	166.67	15.00
1983	24	0	24	0	3	0.05	3	0	8.00
Total	72450				6367	100			11.38

Fig 6.2: Growth of citations vis-à-vis papers, 1980-2005



6.4.10 Distribution of HIV/AIDS papers by the number of citations, 1980-2005

A total of 6367 papers indexed in the ISI's citation indexes were analyzed and grouped in twelve categories in order to compare the citedness (or uncitedness) of HIV/AIDS papers produced by and about E&S African countries. Table 6.10 provides the number of papers in each category of citations, while Table 6.11 examines the uncited papers as a proportion of the cited papers on the one hand, and as a ratio and percentage of the total number of papers on the other. According to the findings in Table 6.10, specifically the last row and second column, there were a total of 1667 uncited papers, i.e. papers that have not been cited. Of these, the highest number (i.e. 472) was recorded in 2005, while 2004 yielded 315 papers. The least number of papers (0 or zero) was recorded in three consecutive years – 1984, 1985, and 1986. Thereafter, the number of uncited papers continued to grow over time except for a few instances when the number slightly dropped. It can also be seen that the uncited records formed the majority, followed by papers that received between 1 and 5 citations. The distribution of papers according to the other categories produced the following pattern: 6-10 citations (896 papers), 11-15 (465), 16-20 (333), 21-25 (188), 26-30 (140), 31-35 (101), 36-40 (72), 41-45 (53), 46-50 (56) and the papers that received more than 50 citations equaled 288.

Table 6.11 shows that uncited papers account for 26.2% of the total number of HIV/AIDS papers in the region, and 40% of the total number of cited papers (4700 in number). Reading the Table from left to right, it can be observed that whereas the proportion and percentage of uncited papers (the last two rows) have shown no clear structured pattern between 1987 and 2000, they demonstrate a continued increase between 2001 and 2005. Thus, the uncited papers accounted for_15.1% in 2001, 20.5% in 2002, 29.9% in 2003, 42.5% in 2004 and 81.2% in 2005.

Table 6.10: Distribution of papers by the number of citations, 1980-2005

	0	1-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45	45-50	>50	TOTAL
1983	2	0	0	0	0	1	0	0	0	0	0	0	3
1984	0	0	1	3	0	0	0	1	0	0	0	0	5
1985	0	0	2	0	0	0	0	0	0	0	0	1	3
1986	0	2	0	0	1	1	1	0	1	0	0	1	7
1987	7	6	2	0	3	1	0	1	0	1	1	2	24
1988	5	14	8	2	4	2	1	0	2	0	0	5	43
1989	5	16	6	5	9	3	2	2	0	1	1	9	59
1990	15	30	14	7	5	3	3	5	2	4	1	14	103
1991	17	44	21	18	8	8	7	4	3	1	4	13	148
1992	19	49	29	16	12	11	5	3	3	2	3	14	166
1993	28	52	27	19	12	10	8	8	4	2	6	16	192
1994	36	58	44	31	22	11	4	7	2	0	3	29	247
1995	41	84	51	23	11	14	13	9	7	8	6	24	291
1996	31	68	40	32	28	13	16	5	5	4	4	23	269
1997	39	102	45	38	27	15	6	5	11	4	5	28	325
1998	65	104	59	31	29	15	19	9	7	4	6	26	374
1999	60	121	61	48	28	19	13	7	12	12	3	32	416
2000	108	160	101	43	46	22	14	15	4	4	4	24	545
2001	86	185	129	59	41	23	13	9	3	2	5	16	571
2002	129	282	114	41	22	8	9	7	5	3	3	5	628
2003	187	277	91	36	16	4	4	3	1	1	1	5	626
2004	315	346	50	13	9	4	2	1	0	0	0	1	741
2005	472	108	1	0	0	0	0	0	0	0	0	0	581
TOTAL	**1667**	**2108**	**896**	**465**	**333**	**188**	**140**	**101**	**72**	**53**	**56**	**288**	**6367**

Table 6.11: Proportion of uncited papers, 1980-2005

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	TOTAL
Uncited (x)	2	0	0	0	7	5	5	15	17	19	28	36	41	31	39	65	60	108	86	129	187	315	472	1667
Cited (y)	1	5	3	7	17	38	54	88	131	147	164	211	250	238	286	309	356	437	485	499	439	426	109	4700
Total x,y	3	5	3	7	24	43	59	103	148	166	192	247	291	269	325	374	416	545	571	628	626	741	581	6367
Proportion x/y	2.0	0.0	0.0	0.0	0.4	0.1	0.1	0.2	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.4	0.7	4.3	0.4
Proportion x/x,y	0.7	0.0	0.0	0.0	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.3	0.4	0.8	0.3
% of Total	66.7	0.0	0.0	0.0	29.2	11.6	8.5	14.6	11.5	11.4	14.6	14.6	14.1	11.5	12.0	17.4	14.4	19.8	15.1	20.5	29.9	42.5	81.2	26.2

6.5 Discussion of the findings

The results presented in section 6.6 provide a detailed evaluation of the authors', institutional and country scientific productivity and impact of HIV/AIDS research by and about E&S Africa between 1980 and 2005. Notably, a sizable number of countries from all over the world are currently involved in HIV/AIDS research in the region. A total of 120 countries (43 African and 77 foreign countries) – including the countries within the scope of this study – have thus far participated. This large number of countries conducting research about the two geographic regions may be attributed to the profileration of the disease in E&S Africa. These two geographic regions are reported to have the highest prevalence rate of HIV/AIDS in the world (UNAIDS 2003a), a scenario which may have called for concerted efforts from all stakeholders from within and outside E&S Africa in the fight against HIV/AIDS. Consequently, South Africa – a country whose prevalence rate is high – registered the highest number of country participants (85), followed by Kenya (71) where HIV/AIDS has been declared a national epidemic. Uganda's case may, however, be different. The countries conducting HIV/AIDS research about the country may have been thrilled by the country's success story in curbing the epidemic (Onyancha & Ocholla, 2004b) and may not necessarily be due to the high levels of the prevalence rate, although this may still apply.

The most productive regional (African) countries were led by South Africa, Kenya, Uganda, Tanzania, Malawi, Zambia, Zimbabwe, Ethiopia, Botswana, and Cameroon. All these countries, save one (i.e. Cameroon), were the focus of this study. South Africa was found to be the most productive, perhaps as a result of the country's improved research units, i.e., the medical research centers and well-funded universities' research programs. South Africa is assumed to have one of the "*largest and most well-developed education networks, especially in tertiary education, in Sub-Saharan Africa*" (Onyancha, 2006:57). Consequently, the education system, whose universities were recently highly ranked (Institute of Higher Education, Shanghai Jiao Tong University [2004]; InternetLab, 2005), has attracted both lecturers and students from other countries who are conducting HIV/AIDS research in the country. Comparatively the frequency of occurrence of regional countries in the address fields was less than that of the foreign countries, implying that regional countries were less productive than their foreign counterparts. This can be attributed to several factors.

According to Mweene (n.d.), effective research in Africa has been hindered by lack of funds and basic facilities, the intellectual and physical isolation of researchers, insufficient personnel to run programs, fragmentation of effort in research, lack of vision and direction by the governments of Africa, and the poor self-image of the region in basic research.

Table 6.2 also shows that the highest number of records in each country was produced by the respective country as shown by highlighted figures in the Table. For instance, out of the 2189 papers that South Africa produced, 1929 were about South Africa. This pattern, according to the researcher, should be naturally expected. Researchers tend to conduct research in and about the country of residence or citizenship. The most productive foreign country was found to be the USA (2429), followed by England with 1412 papers. These two countries recorded a total of 3841 postings which accounted for 54.55% of the total foreign hits (i.e. 7041). This high productivity by foreign countries may partly be attributed to the funding that these countries allocate towards HIV/AIDS research in developing countries in general, and African countries in particular. The pattern may also be attributed to the participation of African students and professionals residing or working in the USA and Great Britain. This observation can be explained better by looking at the following facts reflected in a jointly authored booklet by the Commonwealth Scholarship Commission & Economic and Social Research Council (n.d.:4):

- African institutions are increasingly dependent on foreign expertise. Africa employs up to 150,000 expatriate professionals at a cost of $4bn a year. The expatriates may be authoring HIV/AIDS papers in the name of the parent country.
- There are more African scientists and engineers in the USA than in the entire continent.
- Some 70,000 highly qualified African scholars and experts leave their home countries every year to work abroad, often in more developed countries.
- Since 1990, Africa has been losing 20,000 professionals each year.
- Over 30,000 professionals reside outside Africa.
- 35% of total overseas development aid to Africa is spent on expatriate professionals.

- 70,000 PhDs of African origin are currently in the USA.

With such a large number of African professionals residing in developed countries, and an equally large number of expatriates working in Africa, the pattern of productivity witnessed in this study may not be surprising.

The distribution of papers by the countries of publication was meant to determine countries or geographic regions in which HIV/AIDS research by and about E&S Africa is published and disseminated. It is this researcher's belief that the place of publication of the research findings is important in research evaluation since the place of publication affects access and thus decision making processes. Take for instance a situation where all HIV/AIDS research about a particular country (say country A) is published in a foreign country (e.g. country B). In the first place, these research findings are supposed to assist country A in her formulation of policies regarding intervention programs. It would be extremely difficult to access the source publications in which these research findings are published, especially if these sources require subscription fees (which in most cases are exorbitant), thus negatively impacting on the implementation of the recommendations made therein. Results in Table 6.4 show that, just as in the analysis of the most productive countries, most HIV/AIDS papers were published in foreign countries. It is also worth noting therefore that some papers originated from foreign countries and were actually published in the same category of countries. This is especially true in the case of foreign countries which have access to quality sources to publish in. Unlike foreign countries, most of the papers produced regionally were published in foreign countries. This pattern may be attributed to the desire of local researchers to publish their research findings in foreign sources which are thought to have a larger circulation status, and better reliability and credibility than locally published sources.

The findings on institutional productivity demonstrated that the highest ranking institutions were based in the countries of research. The University of Witwatersrand led, followed by the University of Nairobi, University of KwaZulu Natal, University of Cape Town and Makerere University. All these institutions produced more papers than the highest ranking foreign institution, i.e. the CTR DIS CONTROL & PREVENTION, which produced 252 papers. It was observed that the dominant institutions (i.e. high ranking institutions) were universities in the case of regional institutions. In fact, all the top 6 of the top 36 high ranking institutions were universities. The implication of this is that universities are the primary producers of HIV/AIDS research. This researcher could not, however, ascertain the type of research (i.e. basic/pure or applied) conducted at the universities. However, the cooperation between medical research centers and universities in HIV/AIDS research (see Chapter Four) may imply that universities are involved in carrying out both types of research. Another category of high ranking institutions that conduct research in E&S Africa is that of hospitals or government laboratories. These include the Ministries of Health in various countries, i.e., the Uganda Virus Research Institute, Kenya Government Medical Research Center, Kenya Medical Research Institute, South African Institute of Medical Research, the National Institute of Virology, Baragwanath Hospital and Muhumbili Medical Center, to name a few. A further observation that can be made with regard to the regional institutions is that all the 36 top ranking institutions were located in the countries under investigation. This corresponds with the results on the most productive regional countries. As regards foreign institutions, similar patterns were observed, although the non-university institutions also featured prominently (a similar situation was found in the analysis of regional institutions). For example, the CTR DIS CONTROL & PREVENTION was first in the list of the most productive foreign institutions, with 252 papers. Other non-university institutions include the World Health Organization, Fred Hutchinson Cancer Research Center, NIAID, Blood Transfusion Services, and the Family Health Institute, etc.

An analysis of the most productive authors was initially meant to offer insights into the performance of African authors and compare their performance with that of their foreign colleagues. "*African authors*" refers to citizens and/or residents of African countries living or working within or outside Africa. None of the databases used for data collection provided relevant information for such an analysis. The ISI databases came close to offering such information by providing the authors' institutional affiliations and the authors' addresses. However, since the list of authors and that of the institutions did not match, the researcher could only use the corresponding author's address field to obtain a partial picture. The researcher also resorted to guessing the author's category of affiliation by examining the names of authors. It is worth noting that the latter approach is flawed since it is presently not easy to identify African authors by use of only the authors' names (e.g. surnames). An attempt, though, was made to identify African authors by using the researcher's own knowledge of African names and the corresponding author's field which provides institutional and country affiliation in the records. Looking at Table 6.7 and using the corresponding author's field in the ISI databases, approximately 19 (33.9%) African authors, who produced over 38 papers, were identified. They were led by Ndinya-Achola JO (University of Nairobi, Kenya) and Bwayo JJ (University of Nairobi, Dept Med Microbiology). This figure, although highly doubtful, shows commendable participation from regional authors/researchers.

Interesting results were observed when analyzing the most cited papers. The findings indicate that most HIV/AIDS papers received a relatively high number of citations, which could be interpreted to mean that HIV/AIDS research by and about E&S Africa has had a remarkable influence or impact on the world of scientific research, although the nature of this impact could not be immediately ascertained. The 6367 papers that published HIV/AIDS findings between 1980 and 2005 received a total of 72450 citations. However, higher citation rates should not be misconstrued to always mean that the paper is highly regarded, or is a quality paper. Papers are cited for various reasons (Cronin in King, 1987; Garfield in Smith, 1981:84). It was also observed that all the most cited papers were co-authored by 2 - 20 authors. In fact, there was only one two-author paper. The rest were co-authored by more than 5 authors. This pattern implies that co-authored papers receive more citations than single-authored papers. It was illustrated in Chapter Four that while single-author papers attract an average of 3.48 citations per paper, multiple-author papers receive an average of 12.75 citations per paper. An analysis of the most cited papers by the type of co-authorship revealed that 20 (80%) of them were published in international collaboration. All the remaining most cited works (i.e. 5) were foreignly co-authored, meaning that each paper's authors were based in foreign countries. There were no locally co-authored papers in the top 25 most cited list. Previous studies, though not specifically on HIV/AIDS, have shown that papers published in international collaboration receive more citations than papers written under domestic collaboration. In the words of Katz & Hicks (1997:164), "*collaborating with an author from the home institution or another domestic institution increases the average impact by approximately 0.75 citations* *while collaborating with an author from a foreign institution increases the impact by about 1.6 citations*". Another notable finding was that among the most cited papers, were three papers that were published in 2000 and after. The rest were published between 1988 and 1999. The majority of the most cited papers were those published earlier than 1999. This could be attributed to the time it takes for published articles to be cited after publication. "Citation speed" or "response time" is defined as the "*speed with which a document is used and cited*" (Diodato, 1994:137) and is measured as the time lapse of months or years between the publication of a document and the first time it is cited. Whereas some articles go uncited or take long to be cited after publication due to reasons such as those outlined in subsection 6.2, some remain uncited because they have been recently published and are therefore unknown to researchers. This is evident in the large number of uncited papers published in 2005, the year that this study was conducted.

The patterns and trends of growth of citations vis-à-vis the papers, showed an upward trend for both between 1983 and 1999. Although the number of papers continued to increase after 1999, the number of citations followed a downward trend and so did the average number of citations per paper. The growth of citations over time indicates an increased awareness of the influence/impact of HIV/AIDS research conducted in and about E&S Africa. Notably, there is a reverse relationship between the year of publication and the number of citations received by the papers. The number of citations decreased by 10.69% from 7868 in 1999 to 7027 in 2000, and continued to decrease until 2005 which recorded a total of only 182 citations.

Tables 6.10 and 6.11 make one highly significant revelation about the citedness of HIV/AIDS papers which is that a relatively high percentage of the papers (26.2% of total papers) have remained uncited. 32 papers that were published between 1987 and 1990 have remained uncited to date, while 1991-1999 yielded 336 uncited papers. This is an important observation given that the uncitedness of papers is often taken to mean that the findings reported in the said papers are not worth using. In short, it is assumed that an uncited paper is useless. This feeling has led some scholars to intimate that funding such HIV/AIDS research is a waste of resources (Brown, 1993). Reacting to the high uncitedness of HIV/AIDS papers, Simon Wain-Hobson, "*a highly cited AIDS researcher at the Pasteur Institute in Paris*", asks "*who is paying* *for them*" (Brown, 1993:13). However, it has been shown that uncitedness may be attributed to reasons other than the poor quality of a paper. Some of these reasons are enumerated in subsection 6.2. It can also be noted that most of the uncited papers were published between 2000 and 2005. In fact, the highest number of papers was published in 2005, the period during which this study was conducted. Recently published papers would take some time before they are cited.

6.9 Summary

The main purpose of this Chapter was to measure the productivity and impact of HIV/AIDS research in E&S Africa by evaluating the authors', institutional and countries' productivity and impact in and about E&S Africa between 1980 and 2005. Consequently, the Chapter sought to: determine the most prolific authors of HIV/AIDS papers in and about E&S Africa; study the country-affiliation of HIV/AIDS scientists in order to determine the most productive countries; analyze each author's scientific impact; examine the most prolific organizations/institutions to which the authors belong; identify the most used countries in publishing HIV/AIDS research in and about E&S Africa; and to find out the most cited works.

Results show that the participation of regional authors, institutions and countries in HIV/AIDS research in E&S Africa is commendable. Much of what is produced locally (i.e. in African countries) is published in foreign countries, perhaps due to the authors' desire to publish in the latter category of countries. It is assumed that foreign based sources of publications are of a high quality and enjoy wider circulation which may enhance African authors' visibility and high impact values. Most HIV/AIDS research about E&S Africa that is conducted in foreign countries is published in those countries. This has serious implications, particularly with regard to African researchers accessing previously conducted studies. Such limitations of access may have serious drawbacks in decision making processes regarding intervention programs that these countries would like to put in place.

In was also noted that high ranking regional countries and institutions belong to the E&S African regions which were the subjects of this study. Concerning foreign authorship, most of the foreign produced papers came from the USA and Great Britain. The two countries produced almost half of the total number of papers. They also published an equal amount of papers that originated either from E&S Africa, or foreign countries.

Although we noted a high rate of publication on HIV/AIDS by foreign countries, this pattern may be partly attributed to the use of foreign based databases to obtain data. These databases have been severely accused of being biased in their coverage of source publications. Perhaps a study based on local databases such as SABINET host databases may produce accurate results on regional productivity. It should be noted, however, that it is rather difficult to capture all the papers produced locally because of inadequate record management in the continent as a whole. Citation-wise, the following observations were made:

- Twenty-six point two percent (i.e. 26.2% or 1667) of 6367 records indexed in ISI received no citations. Although this does not imply the uselessness of a paper, the large number of un-cited records raises some concerns about the visibility and impact of HIV/AIDS research in E&S Africa.
- Nevertheless, a trend analysis of the citations shows continued growth, which in turn indicates an increased awareness of the influence of HIV/AIDS research that is conducted in and about E&S Africa.
- Co-authored papers formed the bulk of the most cited papers, with most being those published in international collaboration.

As has been mentioned, it was difficult to identify regional authors, an analysis that was meant to examine domestic and regional productivity and impact. The difficulty stemmed from the fact that ISI's databases do not offer such information. It can also be seen that the results presented in this Chapter considered only the top ranking entities in terms of productivity and impact. Less productive and influential entities were excluded from the presentation.

The next Chapter deals with the subject content analysis of HIV/AIDS literature about E & S Africa.

CHAPTER SEVEN

SUBJECT CONTENT OF HIV/AIDS LITERATURE IN EASTERN AND SOUTHERN AFRICA

7.1 Introduction

In a letter written by Thabo Mbeki in 2000 and addressed to world leaders, the South African president observed that "*it is obvious that whatever lessons we have to and may draw from the West about the grave issue of HIV/AIDS, a simple superimposition of Western experience on African reality would be absurd and illogical*" (as cited in Cohen, 2000b: para 1). Not only do the manifestations of the AIDS disease in Africa differ from those in the West but, as Cohen (2000) observes, AIDS-related diseases, and possibly disease progression itself, differ/s in the continent (i.e from region to region) that is home to about 71% of the global population infected with HIV. In turn, this difference is said to be clinical. To illustrate this, Cohen reports that while tuberculosis amongst AIDS patients is rare in the west – especially, the USA and Europe – it is the most common disease afflicting HIV-positive people in Africa. He further notes that *Kaposi's Sarcoma*, a cancer that causes purple skin blotching, commonly afflicts both HIV uninfected and infected persons in Africa, while in industrialized nations, the disease is largely restricted to HIV-infected, gay men. The same applies to *pneumocysts carinii*, a strain of pneumonia predominant in HIV-infected persons in developed countries. These arguments are based on clinical diagnoses of various diseases in HIV infected persons. Further observations point to how various factors aggravate the spread of HIV/AIDS in developing countries, hence the argument that the impact of HIV/AIDS in these countries is different from that felt in developed countries. This situation calls for a subject content analysis of HIV/AIDS research in E&S Africa in order to: (a) study the trends and patterns of research in different sub-fields of the subject domain; (b) examine the relatedness of various factors and diseases that are commonly associated with HIV/AIDS in Africa.

This Chapter therefore focuses on examining the subject content of HIV/AIDS research on E&S Africa in order to: (a) distinctly bring out the efforts made in various topics and sub-topics/fields of HIV/AIDS research and (b) find out the influence that selected aspects related to HIV/AIDS in Africa have on the disease.

The study sought to answer the following specific research sub-questions:

1. What is the growth rate of HIV/AIDS subject indexing terms (MESH terms)?
2. Which are the most commonly used MESH terms in indexing HIV/AIDS literature?
3. Which sub-fields of HIV/AIDS research are most widely researched?
4. What are the most commonly associated opportunistic infections, pre-disposing factors, risk factors, sexually transmitted diseases, and other tropical diseases, with HIV/AIDS in E&S Africa?

7.2 Implications of a subject content analysis of HIV/AIDS literature

The findings of subject content analyses of HIV/AIDS research would have implications and applications that include the following:

1. Planning intervention programs as well as caring for HIV-infected persons (Cohen, 2000b). Knowledge of the manifestations and features of HIV/AIDS in Africa can lead to the development of appropriate strategies for AIDS patients. These would include, for example, strategies to prolong health and lives by supplying AIDS patients with the right anti-retroviral drugs.

2. Macias-Chapula, Sotolongo-Aguilar, Magde & Solorio-Lagunas (1999:565) argue that a subject content analysis of AIDS literature would mirror "*not only the construction of this field by specific institutions, but also what happens to subject access as the knowledge base and environment of a discipline grow and change*". Bierbaum & Brooks (1995) acknowledge that in order for one to maximize one's use of a database or have comprehensive access to AIDS literature, one needs to be knowledgeable about the terms and phrases used to index the literature. They observe that:

   > "*In order to be assured of making a comprehensive search of the medical literature for AIDS-related citations, one would have to have a rather thorough and up-to-date knowledge of the terminology of the field*" (Bierbaum & Brooks, 1995:536)

3. Growth of knowledge in a subject domain may be reflected in new and emerging topics studied in that subject domain. For instance, at the beginning of the AIDS epidemic, very little was known or mentioned about anti-retroviral drugs, hence these never featured in AIDS literature. Today, the issue of anti-retroviral drugs is central in both the general print media and journals.

4. A subject content analysis can also identify what Bierbaum & Brooks (1995:533) term as the "*rising and falling frequency*" of the occurrence of the subject headings. The authors observe that such data can be used to "*infer the changing level of interest in a particular aspect of AIDS researc*h" and to "*track the introduction of new terms that reflect innovations and discoveries in the knowledge base*" (Bierbaum & Brooks, 1995:533).

7.3 Bibliometric studies of HIV/AIDS literature

Studies that have set out to specifically evaluate the subject content of HIV/AIDS literature are few. Literature review reveals that the studies that have been conducted in order to analyze the publishing trends and patterns in different sub-topics/fields of HIV/AIDS have been general in nature. For instance, although Onyancha & Ocholla (2006) sought to generally examine HIV/AIDS literature specific to young persons, they nevertheless made mention of the subject content of the literature. In another study, Onyancha & Ocholla (2004b) aimed to compare HIV/AIDS research on Kenya and Uganda in general terms. However, one of the variables analyzed in that study was the publishing activity in different sub-fields of HIV/AIDS. Similarly, Macias-Chapula & Mijangos-Nolasco (2002) conducted a bibliometric study on AIDS literature in Central Africa in which they also looked at the topical HIV/AIDS issues that papers publish. A review of Macias-Chapula's (2000) study on AIDS in Haiti reveals approaches similar to the aforementioned studies.

That notwithstanding, these studies and others have identified research areas that are commonly focused on in HIV/AIDS research. Patterns of literature production indicate that the top ranked subject headings include HIV infections, Acquired Immunodeficiency Syndrome, sex education and sex behavior (Bierbaum & Brooks, 1995; Macias-Chapula, 2000; Macias-Chapula & Mijangos-Nolasco, 2002; Macias-

Chapula, Sotolongo-Aguilar, Magde & Solorio-Lagunas, 1998; Onyancha & Ocholla, 2004b; Onyancha & Ocholla, 2006).

Bierbaum & Brooks (1995) offer a favorably in-depth analysis of the subject content of AIDS literature at an international level. Using the AIDSLINE database to collect data, the authors analyzed a total of 12,987 HIV/AIDS records published in 1992, and compared the 30 top-ranked subject headings in 1992 with those of 1989. The 1992 rankings showed some stability particularly with regard to the first 8 subjects which included Human, HIV infections, Acquired Immunodeficiency Syndrome, Male, Female, Adult, HIV seropositivity and Support, Non-U.S. Govt. There were, however, shifts in subsequent group ranks. Terms that did not feature at all in the 30 top-ranked terms in 1989, emerged in 1992's list. These included HIV infections, HIV seropositivity, Comparative study, Sex behavior, molecular sequence data, opportunistic infections, and Substance abuse, Intravenous. Others were Leukocyte Count, Base sequence, T-4 lymphocytes, pregnancy, zidovudine, Amino acid sequence, Cell Line, Polymerase Chain Reaction, and follow-up studies. Some of the indexing terms, derived from the Medical Subject Headings (MESH) thesaurus of the National Library of Medicine, identify the type of research, geographic region, type of study, and form of literature. In the analysis of the records by the subheading terms, /complications, /epidemiology, /prevention and control, and /transmission topped the list of the 10 top-ranked terms in 1992. These sub-fields of HIV/AIDS research were centers of interest in 1989, although there were a few shifts in rank for some of them, e.g. /complications, which ranked 7th in 1989 jumped to first in 1992.

A study similar to that of Bierbaum & Brooks (1995) was conducted in Latin America by Macias-Chapula, Sotolongo-Aguilar, Magde & Solorio-Lagunas (1998). Similar findings were reported, whereby AIDS and HIV terms obtained high ranks, while the check tags 'human', 'female', 'male', 'adult', 'adolescence', 'middle age', and 'child' exhibited strong occurrence, and the check tag 'human' came first throughout the entire period of study, i.e. 1982-1998. The subheadings /epidemiology, /prevention and control, and /treatment were ranked highly for both AIDS and HIV infections. Slight shifts in rank occurred in a few main subject headings and subheadings in the two decades of study.

The rest of the studies (Macias-Chapula, 2000; Macias-Chapula & Mijangos-Nolasco, 2002; Onyancha & Ocholla, 2004b; Onyancha & Ocholla, 2006) agree with the findings of Bierbaum & Brooks (1995) and Macias-Chapula, Sotolongo-Aguilar, Magde & Solorio-Lagunas (1998). Their general observation is that HIV infections and Acquired Immunodeficiency Syndrome are the main dominant subject headings, while epidemiology, prevention and control, and transmission are highly regarded areas of study in HIV/AIDS research. Further research to explore the trends – through trend analysis – of research on the main subject headings and subheadings of HIV/AIDS in Africa over a longer period of time may provide a clearer picture of how to support decision making processes in the region.

7.4 Methods and Procedures

This section provides the approaches and techniques that were used to conduct a subject content study of the HIV/AIDS literature.

7.4.1 Research method and techniques

Generally, the content analysis method was used to evaluate the publishing activity in various sub-fields of HIV/AIDS research as well as find out the relatedness of the risk factors, pre-disposing factors, opportunistic infections, sexually transmitted diseases and other tropical diseases to HIV/AIDS. (For further information on content analysis, see Chapter Three, section 3.3). One of the content analysis methods used to analyze HIV/AIDS papers was co-word analysis. Co-word analysis is defined as a content analysis method that "*reveals patterns and trends in technical discourse by measuring the association strengths of terms representative of relevant publications or other texts produced in a technical field*" (Coulter, Monarch & Konda, 1998:1206). The method is meant to identify associations between publication descriptors in order to determine themes and trends in a discipline (Kostoff, 2001). Co-word analysis provides a set of terms or descriptors that not only regularly occur together in a text or record, but also [may be used to] measure the regularity with which events occur (Jacobs, 2002). Thus, the process "*measures the strength of association between two or more documents by the co-occurrence of the same 'words' (phrases, descriptors, classification codes, etc) in a chosen field*". Contextually, the term 'documents' refers to the title, abstract, and/or descriptor fields (Callon et al in Schneider & Borlund, 2004:537).

This method has been extensively used, as illustrated and exemplified in its published literature (Callon, Law & Rip, 1986; Leydesdorff, 1988; Turner, Chartron, Laville, & Michelet, 1988; Courtial & Law, 1989; Whittaker, 1989; Callon, Courtial & Laville, 1991; Law & Whittaker, 1992; Courtial, 1994; Coulter, Monarch & Konda, 1998; Kopcsa & Schiebel, 1998; Bookstein & Raita, 2001; Ding, Chowdhury & Foo, 2001; Jacobs, 2002; Krsul, 2002; Aizawa & Kageura, 2003; Baldwin, Hughes, Hope, Jacoby & Ziebland, 2003; Bookstein, Kulyukin, Raita, Nicholson, 2003; Schneider & Borlund, 2003; Hui & Fong, 2004; and Onyancha & Ocholla, 2005). The different approaches and ways that co-word analysis has been applied in a variety of studies confirms Leysdedorff's (1988:209) observation that "*since most science studies and nearly all science policy studies use institutionally defined sets of documents, this instrument [co-word analysis] could have a wide range of applications*".

The Co-word analysis technique has been most commonly utilized in mapping or tracing patterns and trends in term associated-ness. Most of the aforementioned studies fall in this category. We briefly provide a glimpse of the applicability of co-word analysis by reviewing a few of the studies that have used the method, beginning with Aizawa & Kageura (2003), who used the technique to calculate the association between technical terms based on co-occurrences in keyword lists of academic papers. The technique was also employed by Baldwin, Hughes, Hope, Jacoby & Ziebland (2003), who mapped ethics and dementia literature in order to identify dominating ethical issues, new and emerging areas of interest and those areas triggered by external events such as legal cases. Onyancha & Ocholla (2005) used co-word analysis to measure the relatedness of opportunistic infections to HIV/AIDS at an international level. The authors noted a strong relationship between HIV/AIDS and Tuberculosis, Toxoplasmosis, Candidiasis, cytomegalovirus, etc. Further examples of applications include: Kostoff (2001), who used the method to identify research themes in software engineering that (1) remained constant (2) matured and diminished as major research topics and (3) emerged as predominant research topics throughout the period of study; Jacobs (2002), who employed co-word analysis to study the use of particular words to describe respondents' job functions and the citation of information sources; and Schneider & Borlund (2004), who considered the applicability of co-word analysis in the construction and maintenance of thesauri. Citing several authors, Schneider & Borlund (2004:537) noted that the "*units of analysis connected to co-word analysis (i.e. words, phrases, and descriptors) may illustrate cognitive structures of a field when displayed in so-called 'semantic maps'*".

7.4.2 Data Analysis and Presentation Procedures

Only data obtained from the MEDLINE database was analyzed in this section. The MEDLINE database provides an elaborate classification of the topics indexed therein, a factor that largely dictated the choice of the database for a content analysis of the HIV/AIDS literature. Furthermore, since only MEDLINE titles of HIV/AIDS literature were considered for co-word analysis, it became necessary, for the purposes of comparison, to use the subject terms as supplied by the same database.

Three approaches were used to study the content of HIV/AIDS literature about E&S Africa, as follows:

1. An examination of the MESH sub-headings of HIV and AIDS in order to distinctly bring out the efforts made in various sub-fields of HIV/AIDS research in E&S Africa.
2. A trend analysis of the MESH terms in order to find out the most researched topics in HIV/AIDS research in E&S Africa.
3. A co-word analysis of the title words using a constructed set of words/names that included: (a) Opportunistic diseases (b) Pre-disposing factors (c) Risk factors (d) sexually transmitted diseases and (e) Other diseases (especially tropical diseases) in order to examine their relatedness to HIV/AIDS in E&S Africa.

For bullets one and two above, the Bibexcel computer software was used to obtain frequencies of the main MESH terms and sub-topics of HIV/AIDS literature. Thirty (30) top ranking MESH terms were identified for each year period. The entire period of study was split into 9 three-year periods, save for the 2004-2005 year period, which consisted of two years within short time periods. In this way, it was easy to monitor any shifts in research. The approach of obtaining the final MESH term frequencies previously used by Macias-Chapula, Sotolongo-Aguilar, Magde & Solorio-Lagunas (1999) was adopted in the study. Each subject heading was treated as distinct, meaning that if a subject heading appeared two or more times in different formats i.e.:

HIV/Infections*

HIV/Infections

*HIV/*Infections*

- they were treated as one descriptor but counted as three entries for HIV.

Data generated from this analysis was presented in 5 Tables. The terms in each year period were compared with those in the subsequent or previous year periods in order to find out:

1. Subject/topical terms that may have disappeared;
2. Subject/topical terms that were relegated to inferior ranks; and
3. Emerging subject/topical terms.

Regarding the co-word analysis, five lists of the diseases and factors were initially drawn from our personal experience with their usage in literature. Several sources (e.g. Nordberg, 2001; Conlon & Snydman, 2004) were thereafter consulted to refine the lists. Finally, expert advice was sought from a resident medical doctor and lecturers in the Departments of Nursing (University of Eastern Africa, Baraton and University of Zululand, respectively) who advised us on the terms that needed to be dropped from, or added to the lists. Extreme caution was taken to ensure that the lists were as exhaustive as possible. Two computer files were prepared, namely, words.txt (containing the words/names in Appendix B) and text.txt (containing titles of HIV/AIDS records) for analysis. Various authors (e.g. Luhn, Feinberg, Buxton, Manten, and Tocatlian, all as cited by Yitzhaki, 2001:759) have noted that titles are very important components of any scientific or scholarly article as they form part of the access points in search and retrieval processes. According to Yitzhaki (2001:759), many information retrieval systems "*depend heavily on indexing by automated, computerized selection of words from article titles*". Perhaps this is why great importance is placed on highly informative titles and it was on this basis that we considered the title words for a co-word analysis.

Data (i.e. words.txt and text.txt) was analyzed using TI.exe computer application software, developed by Prof. Leysdedorff, University of Sweden. The co-occurrence files thus generated (i.e. COOCC.DBF and COSINE.DBF) were exported to UCINET for the preparation of computer files that could be used by Pajek Software to construct visual maps of the associated-ness of HIV/AIDS with each of the variables (i.e.

words/names). Leydesdorff (2004) explains that *coocc.dbf* contains a co-occurrence matrix of the words found in the texts. In turn, this matrix is symmetrical and contains the words both as variables and as labels in the first field. The main diagonal is set to zero. The number of co-occurrences is equal to the multiplication of occurrences in each of the texts. *Cosine.dbf* contains a normalized co-occurrence matrix of the words from the same data. Normalization is based on the cosine between the variables conceptualized as vectors (Salton & McGill as cited by Leysderdorff, 2004). Both files (*coocc.dbf* and *cosine.dat*) contain the information in DL-format. Whereas the file *coocc.dbf* consists of co-occurrence frequencies, *cosine.dat* contains the strengths of ties between two or more words in the text, in which case the value ranges between zero and one whereby the higher the value, the stronger the relationship between the words.

Finally, the findings from the aforementioned three analyses were compared with results from previously conducted international and foreign studies in order to find out whether there were differences that would warrant a generalized conclusion that HIV/AIDS in Africa is a distinct disease.

7.5 Presentation of the findings

This section presents the findings under four broad sub-headings, namely:

- Growth of MESH terms, 1980-2005
- Trends of HIV/AIDS' Main MESH topics, 1980-2005
- Trends of HIV/AIDS' MESH sub-topics, 1980-2005
- Co-occurrence of HIV/AIDS and other selected terms

7.5.1 Growth of MESH Terms, 1980-2005

Table 7.1 provides a trend analysis of the number of MESH main terms from 1980-2005. It was observed that the number of terms had risen from just 127 at the beginning of the epidemic (i.e. 1980-1982), to 25524 in 2001-2003, an increase of 19997.6%. There was a decrease in the number of terms by 8400 between 2001-2003 and 2004-2005. This could be attributed to the few years covered in the latter period or the indexing time lag. Recently published documents also take longer to be entered into a database. Another notable observation concerns the inverse relationship between the number of MESH main terms and the average number of terms per record. Whereas the number of MESH main terms has shown exponential growth, there was a mixed pattern in the average number of terms per record.

Table 7.1: Growth of MESH main Terms, 1980-2005

Year	No. of Terms	Change in no. of Terms	Change in %	Records	Terms per Record
2004-2005	17124	-8400	-32.91	1039	16.48
2001-2003	25524	5888	29.99	1603	15.92
1998-2000	19636	3497	21.67	1256	15.63
1995-1997	16139	6242	63.07	998	16.17
1992-1994	9897	3263	49.19	620	15.96
1989-1991	6634	4544	217.42	464	14.30
1986-1988	2090	1637	361.37	152	13.75
1983-1985	453	326	256.69	31	14.61
1980-1982	127	-	-	9	14.11

7.5.2 Trends of research in HIV/AIDS' main MESH Topics

A trend analysis was performed between 1980 and 2005 to monitor the emergence and disappearance of certain topics and to find out the most researched topic throughout the entire period of study.

7.5.2.1 1980-1982

Table 7.2 provides the top ranking topics of research at the beginning of the HIV/AIDS epidemic, i.e. 1980 to 1982. At the top of the Table is Burkitt Lymphoma with 9 hits, followed by Antibodies, Bacterial (7), Antibodies, Viral (5), and Herpesvirus 4, Human (5). Others are Age Factors (2), Altitude (2), Escherichia Coli (2), Hepatitis, Viral, Human (2), Immunoglobulin A, Secretory (2), Liver Diseases (2), Milk, Human (2), Parainfluenza Virus 3, Human (2), Pregnancy (2) and Antigens, Viral (2). The other topics registered one hit each.

7.5.2.2 1983-1985

The 1983-1985 year period saw the emergence of a descriptor that is specific to the subject of HIV/AIDS, i.e. Acquired Immunodeficiency Syndrome - as a subject indexing term. Acquired Immunodeficiency Syndrome tops the list of 30 top ranking topics with a total of 29 postings, while Sarcoma, Kaposi is in second position with 22 hits, followed by Retroviridae Infections (15), Adolescence (15), Antibodies, Viral (14), and Deltaretrovirus (13). Burkitt Lymphoma, which was first in the previous Table, here is rated 6th. Likewise, Herpesvirus 4, Human has moved from 4th position in Table 7.2 to 7th in Table 7.3. Besides Acquired Immunodeficiency Syndrome, other new entrants to the list of 30 top ranking topics include Sarcoma, Kaposi; Retroviridae Infections; Deltaretrovirus; Homosexuality; and Nasopharyngeal Neoplasms. There were a total of 22 out of 30 new descriptors in the top ranking terms in Table 7.3. An equal number that previously featured (i.e. 1980-1982) did not appear in 1983-1985. The topics that ranked highly in both two year-periods (Tables 7.2 & 7.3) equaled only 7, and included adolescence (which jumped from 6th position to 4th); Antibodies, Viral; Burkitt Lymphona; Herpesvirus 4, Human; Antigens, Viral; Age factors; Immunoglobin A; and Hepatitis, Viral, Human.

Table 7.2: Distribution of records by the main MESH terms, 1980-1982

Rank	MESH Term	No. of Hits	Rank	MESH Term	No. of Hits
1	Burkitt Lymphoma	9	6	Adenovirus Infections, Human	1
2	Antibodies, Bacterial	7	6	Adenoviruses, Human	1
3	Antibodies, Viral	5	6	Adolescence	1
4	Herpesvirus 4, Human	5	6	Antibody Specificity	1
5	Age Factors	2	6	Carcinoma, Hepatocellular	1
5	Altitude	2	6	Colostrum	1
5	Escherichia coli	2	6	DNA, Viral	1
5	Hepatitis, Viral, Human	2	6	Enterotoxins	1
5	Immunoglobulin A, Secretory	2	6	Hepatitis B Core Antigens	1
5	Liver Diseases	2	6	Hepatitis B Surface Antigens	1
5	Milk, Human	2	6	Hepatitis B virus	1
5	Parainfluenza Virus 3, Human	2	6	Hepatitis C	1
5	Pregnancy	2	6	Hepatovirus	1
5	Antigens, Viral	2	6	Immunoglobulin M	1
6	Adenoviridae Infections	1	6	Lactation	1

7.5.2.3 1986-1988

This year period saw yet again several HIV/AIDS-specific subject descriptors, i.e. HIV, HIV antibodies, HIV infections, and HIV Seropositivity added into the MESH thesaurus. These descriptors are ranked 6th, 5th, 7th and 2nd behind Acquired Immunodeficiency Syndrome which tops the list, Antibodies (2nd), Viral (3rd) and Adolescence (4th). Only one-fifth of the 30 top ranked descriptors in Table 7.4 appeared in Table 7.3. Most of the descriptors (24/30 or 80%) had been relegated to the periphery, or disappeared altogether. There were 24 new descriptors that either improved their positions or were introduced into the MESH thesaurus. These include, among others, the aforementioned HIV/AIDS-specific descriptors; Pregnancy; Health Education; Organization and Administration; Sexually Transmitted Diseases; Disease; and Communication. Others that thereafter maintained a continued presence are: Risk Factors; Prostitution; and Sexual Behavior.

Table 7.3: Distribution of records by the main MESH terms, 1983-1985

Rank		No. of Hits	Rank		No. of Hits
1	Acquired Immunodeficiency Syndrome	29	10	Enzyme-Linked Immunosorbent Assay	3
2	Sarcoma, Kaposi	22	10	Disease Outbreaks	3
3	Retroviridae Infections	15	10	Diarrhea	3
3	Adolescence	15	10	Body Weight	3
4	Antibodies, Viral	14	10	Antigens, Viral	3
5	Deltaretrovirus	13	10	Age Factors	3
6	Burkitt Lymphoma	12	11	Syndrome	2
7	Herpesvirus 4, Human	8	11	Neoplasms, Multiple Primary	2
8	Homosexuality	5	11	Lymphopenia	2
9	Nasopharyngeal Neoplasms	4	11	Immunoglobulin A	2
9	Diagnosis, Differential	4	11	Hepatitis, Viral, Human	2
10	Sex Factors	3	11	Epidemiologic Methods	2
10	Risk	3	11	Entamoebiasis	2
10	Malaria	3	11	Cytomegalovirus Infections	2
10	Lymphoma	3	11	Chlamydia Infections	2

Table 7.4: Rank distribution of MESH Terms by the total number of records, 1986-1988

Rank		No. of Hits	Rank		No. of Hits
1	Acquired Immunodeficiency Syndrome	172	14	Research	12
2	HIV Seropositivity	38	15	Mass Screening	11
3	Antibodies, Viral	36	15	Enzyme-Linked Immunosorbent Assay	11
4	Adolescence	34	16	Risk Factors	10
5	HIV Antibodies	32	16	Prostitution	10
6	HIV	30	16	Health Services	10
7	Virus Diseases	28	16	Health Planning	10
7	HIV Infections	28	16	Delivery of Health Care	10
8	Pregnancy	20	17	Malaria	9
9	Health Education	18	18	Sexual Behavior	8
10	Organization and Administration	16	18	Population Characteristics	8
11	Sexually Transmitted Diseases	15	18	Information Services	8
12	Sarcoma, Kaposi	14	18	Infection	8
12	Disease	14	18	AIDS-Related Complex	8
13	Communication	13	19	Education	7

7.5.2.4 1989-1991

Table 7.5 provides a list of the 30 top ranking descriptors between 1989 and 1991. It was noted that there were 13 new descriptors, meaning that the number of descriptors that maintained high ranking status in two consecutive year-periods (for 6 years) had improved by over 100% (i.e. from just 6 in the 1986-1988 to 13 in 1989-1991). The new descriptors included (in descending order of occurrence): HIV-1; Prevalence; Tuberculosis, Pulmonary; Tuberculosis; Health Knowledge, Attitudes, Practice; AIDS-Related Opportunistic Infections; Urban Population; Pregnancy Complications, Infectious; Demography; Counseling; Contraceptive Devices, Male; and Socioeconomic Factors. The number of descriptors that appeared in both Tables 7.4 and 7.5 were 17, and were led by Acquired Immunodeficiency Syndrome followed by, HIV Infections; HIV Seropositivity; Adolescence; Sexual Behavior; Risk Factors;

and Sexually Transmitted Diseases. The number of hits for most of the common descriptors has indicated an upward trend. Worth noting also is the quick rise of the subject heading 'HIV Infections' from position seven in Table 7.4 to the 2nd position in Table 7.5.

Table 7.5: Distribution of records by the main MESH terms, 1989-1991

Rank		No. of Hits	Rank		No. of Hits
1	Acquired Immunodeficiency Syndrome	407	15	Tuberculosis	35
2	HIV Infections	262	16	HIV Antibodies	35
3	HIV Seropositivity	127	16	Health Knowledge, Attitudes, Practice	32
4	Adolescence	114	17	AIDS-related Opportunistic Infections	30
5	HIV-1	103	18	Enzyme-Linked Immunosorbent Assay	29
6	Sexual Behavior	63	19	Urban Population	28
6	Risk Factors	63	20	Prostitution	28
7	Sexually Transmitted Diseases	57	21	Delivery of Health Care	26
8	Health Education	53	24	Pregnancy Complications, Infectious	24
9	Virus Diseases	50	24	Demography	24
10	Disease	46	24	Counseling	24
11	Prevalence	42	24	Contraceptive Devices, Male	24
12	Tuberculosis, Pulmonary	41	25	Socioeconomic Factors	23
13	Pregnancy	40	25	Organization and Administration	23
14	HIV Seroprevalence	36	26	Research	22

7.5.2.5 1992-2005

The previous years had witnessed a turbulent period in which most descriptors changed positions. New terms were introduced into the MESH thesaurus, while others either disappeared completely or were relegated into ranks lower than the 30-rank threshold. Nevertheless, as Table 7.5 shows, descriptors had started stabilizing by 1989-1991 and about 17 descriptors had maintained and/or improved their rankings from the previous year period. This is well illustrated in Table 7.6, which provides a rank distribution of 57 MESH subject headings from 1992 to 2005 (14 years), quite unlike the 89 descriptors that were high ranking topics of research between 1980 and 1991 (12 years).

Until 1992, Acquired Immunodeficiency Syndrome was the most researched topic. Table 7.6 shows, however, that this descriptor exchanged positions with HIV Infections which, from 1992 to 2005, came first. Other descriptors that ranked highly throughout the period were: HIV-1; Adolescence; Pregnancy Complications, Infectious; Anti-HIV Agents; Pregnancy; Risk Factors; Disease Transmission, Vertical; HIV Seropositivity; Prevalence; and Sexual Behavior.

Table 7.6: Rank distribution of the main MESH terms, 1992-2005

No.	*Main MESH Terms*	*1992-1994*	*1995-1997*	*1998-2000*	*2001-2003*	*2004-2005*
1	HIV Infections	1	1	1	1	1
2	Acquired Immunodeficiency Syndrome	2	2	2	2	2
3	HIV-1	4	4	3	3	3
4	Adolescence	3	3	4	4	4
5	Pregnancy Complications, Infectious	21	24	8	9	5
6	Anti-HIV Agents			6	3	6
7	Pregnancy	14	15	5	6	7
8	Risk Factors	7	10	14	11	8
9	Disease Transmission, Vertical			11	13	9
10	HIV Seropositivity	6	7	7	7	10
11	Prevalence	13	12	10	10	11
12	Sexual Behavior	10	11	15	15	12
13	AIDS-Related Opportunistic Infections	8	8	12	8	13
14	Sexually Transmitted Diseases	11	9	9	12	13
15	Tuberculosis	15	13	13	16	14
16	Tuberculosis, Pulmonary	15	68	15	14	14
17	Condoms	20		22	21	15
18	Health Knowledge, Attitudes, Practice	19	14	17	20	16
19	CD4 Lymphocyte Count			22	18	17
20	Nevirapine				19	17
21	Viral Load					18
22	CD8-Positive T-Lymphocytes					19
23	Incidence		26	18	17	20
24	Anti-Retroviral Therapy, Highly Active					21
25	Treatment outcome					22
26	Social Economic Factors		25		28	23
27	Risk Taking					24
28	Breast Feeding					25
29	Sexual Partners					26
30	Anti-Retroviral Agents				27	27
31	Virus Diseases	5	5	14		
32	Disease	6	6	14		
33	HIV Seroprevalence	9	23	21		
34	Age Factors	12	24			
35	Health Education	16	16	20		
36	Demography	17	18			
37	Population	18	20			
38	HIV Antibodies	18	25			
39	Economics	22	19			
40	Rural Population	23		23	23	
41	Family Planning Services	23				
42	Education	24				
43	Health Planning	25				
44	Population Characteristics	26	27			
45	Research		17			
46	Organization and Administration		21			
47	Sarcoma, Kaposi		28			
48	Disease outbreaks			16	22	
49	Zidovudine			19		
50	Health policy			23		
51	HIV Envelope Protein gp120			23		
52	Politics			23		
53	AIDS vaccines				27	
54	Drug industry				24	
55	HIV seronegativity				26	
56	Molecular Sequence Data				26	
57	Rural Health				25	

A few terms have recently emerged to join the top 10 in 2004-2005. These include Anti-HIV Agents and Disease Transmission, Vertical (which appeared in 1998-2000), Nevirapine, Viral Load, CD8-Positive T-Lymphocytes, Anti-Retroviral Therapy (Highly Active), Treatment Outcome, Risk Taking, Breast Feeding, Sexual Partners and Anti-Retroviral Agents. It can be observed that most of the terms that were ranked among the top terms in 1992-1994, 1995-1997 and 1998-2000 did not feature in 2004-2005's top ranking MESH subject headings. These include Virus Diseases, Disease, HIV Seroprevalence, Age Factors, Health Education, Demography, Population, HIV Antibodies, Economics, Rural Population, Family Planning Services, Education, and Health Planning, among others.

7.5.3 Trends of research in HIV/AIDS' MESH Sub-Topics

Macias-Chapula, Sotolongo-Aguilar, Magde & Solorio-Lagunas (1999) and Bierbaum Brooks & Brooks (1992) opine that a study of the subheadings would reveal the importance placed on specific areas of research in a broader subject or topic at a given time. Table 7.7 reveals that there were several subheadings that were ascribed to both Acquired Immunodeficiency Syndrome (AIDS) and HIV Infections. There were a total of 32 HIV/AIDS subheadings. The heading "Acquired Immunodeficiency Syndrome" consisted of 29 sub-headings, while all the 32 subheadings were focus areas of research under HIV Infections. At the top of the list (arranged according to the total number of postings) are epidemiology (1986), Prevention & Control (1565), Transmission (1036), Complications (948), and Drug Therapy (561). Reading Table 7.7 from left to right indicates that epidemiology and immunology ranked first in 1983-1985 with 6 postings each, followed by diagnosis (5), and transmission and complications which yielded 3 hits each. Other subheadings that featured in 1980-1982 were microbiology and pathology, which held 5th position in that year, followed by blood and etiology which came 6th. Another revelation is that all the subheadings appearing between 1983 and 1988 were associated with AIDS. The descriptor "HIV Infections" was introduced in 1988 (Bierbaum, Brooks & Brooks, 1992) as shown in Table 7.3 above. The quick rise of drug therapy, particularly since 1998, perhaps reveals that research is increasingly focusing on the use of drugs associated with HIV/AIDS. Other subheadings that rose quickly to rank among the most HIV/AIDS-associated terms include virology, mortality and economics.

Table 7.7: Research in Sub-fields of HIV and AIDS

Rank		*Overall Rank*	*Sub-Field of Study*	*1983-1985*		*1986-1988*		*1989-1991*		*1992-1994*		*1995-1997*		*1998-2000*		*2001-2003*		*2004-2005*		*Sub-total*		*TOTAL*
AIDS	HIV	AIDS/HIV		AIDS	HIV	AIDS	HIV	AIDS	HIV	AIDS	HIV	AIDS	HIV	AIDS	HIV	AIDS	HIV	AIDS	HIV	AIDS	HIV	
1	1	1	Epidemiology	6	0	47	0	101	66	88	114	61	159	106	284	132	450	67	305	608	1378	1986
2	2	2	Prevention & Control	0	0	23	0	54	21	72	43	79	113	100	241	127	361	72	259	527	1038	1565
3	3	3	Transmission	3	0	22	0	52	20	40	51	47	103	44	194	38	210	25	187	271	765	1036
4	4	4	Complications	3	0	16	0	48	40	41	65	28	105	25	148	28	225	14	162	203	745	948
5	5	5	Drug Therapy	0	0	1	0	5	2	2	5	10	8	43	59	71	181	47	127	179	382	561
8	6	6	Immunology	6	0	11	0	13	14	7	21	9	34	16	65	22	92	6	74	90	300	390
10	7	7	Diagnosis	5	0	10	0	17	10	13	16	7	32	14	71	10	81	12	79	88	289	377
11	8	8	Virology	0	0	0	0	0	0	0	9	7	22	38	72	13	103	9	78	67	284	351
7	9	9	Psychology	0	0	2	0	18	11	20	9	29	30	12	31	24	45	17	53	122	179	301
6	10	10	Mortality	0	0	1	0	5	1	10	11	16	10	19	35	52	50	28	51	131	158	289
9	12	11	Economics	0	0	0	0	6	2	5	2	3	9	18	19	44	51	13	29	89	112	201
8	13	12	Therapy	0	0	1	0	4	5	20	8	11	10	22	22	22	34	10	28	90	107	197
15	11	13	Blood	1	0	1	0	2	1	6	12	5	20	4	27	5	55	4	25	28	140	168
14	14	14	Ethnology	0	0	0	0	3	6	3	6	11	17		14	9	25	8	12	34	80	114
13	15	15	Etiology	1	0	3	0	3	1	1	4	2	11	21	16	7	17	1	19	39	68	107
16	16	16	Physiopathology	0	0	0	0	2	3	1	3	4	2	7	18	10	22	1	16	25	64	89
12	18	17	Nursing	0	0	2	0	5	1	6	3	3	2	7	4	14	15	7	14	44	39	83
17	17	18	Microbiology	2	0	0	0	5	2	6	12	0	5	3	7	4	11	0	5	20	42	62
18	17	19	Pathology	2	0	1	0	1	2	0	4	3	3	5	7	3	18	3	8	18	42	60
20	19	20	Genetics	0	0	0	0	0	0	0	1	1	1	2	8	1	9	1	11	5	30	35
19	20	21	Classification	0	0	0	0	2	0	1	2	1	3	0	5	2	4	0	4	6	18	24
22	21	22	Metabolism	0	0	0	0	1	0	0	0	0	0	2	3	0	6	0	5	3	14	17
20	22	23	Congenital	0	0	0	0	1	0	2	1	1	0	0	2	1	3	0	2	5	8	13
20	22	24	Parasitology	0	0	0	0	2	0	1	0	0	1	0	0	2	2	0	2	5	5	10
21	23	25	History	0	0	0	0	0	0	1	2	0	0	0	0	3	1	0	1	4	4	8
24	22	26	Radiology	0	0	0	0	0	0	0	0	1	2	0	0	0	3	0	0	1	5	6
24	23	26	Surgery	0	0	0	0	0	0	0		1	0	0	1	0	3	0	1	1	5	6
23	24	26	Rehabilitation	0	0	0	0	0	0	1	1	0	0	0	0	0	1	1	2	2	4	6
24	25	27	Urine	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	1	3	4
25	25	28	Cerebrospinal Fluid	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1
25	25	28	Diet Therapy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
25	25	28	Ultrasonography	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1

Note: The MESH main terms "Acquired Immunodeficiency Syndrome" and "HIV Infections" have been abbreviated so that the Table can fit onto one page.

Fig. 7.1: Co-occurrence of HIV/AIDS and Opportunistic Infections

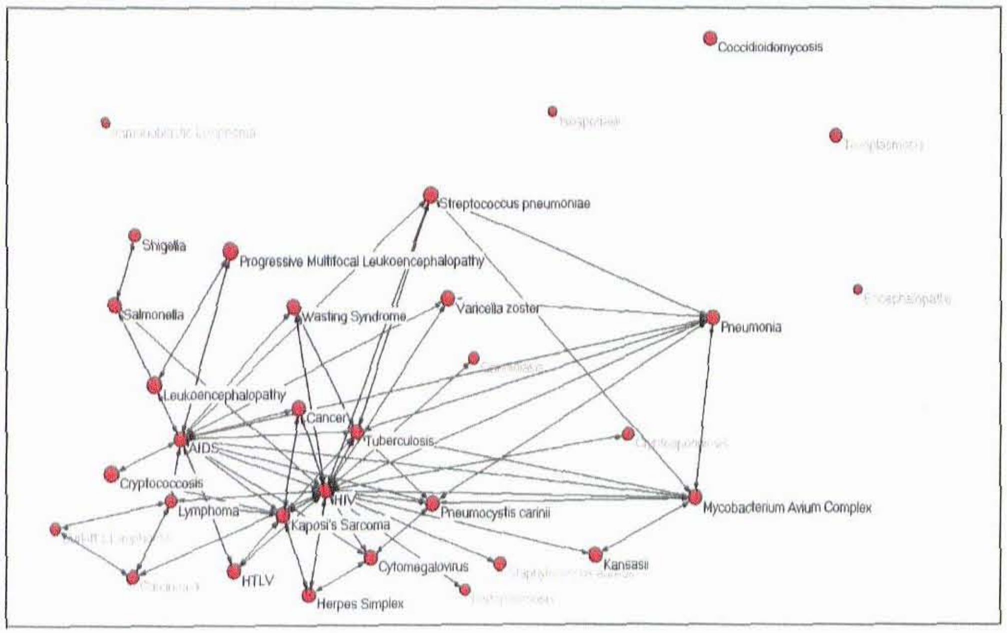
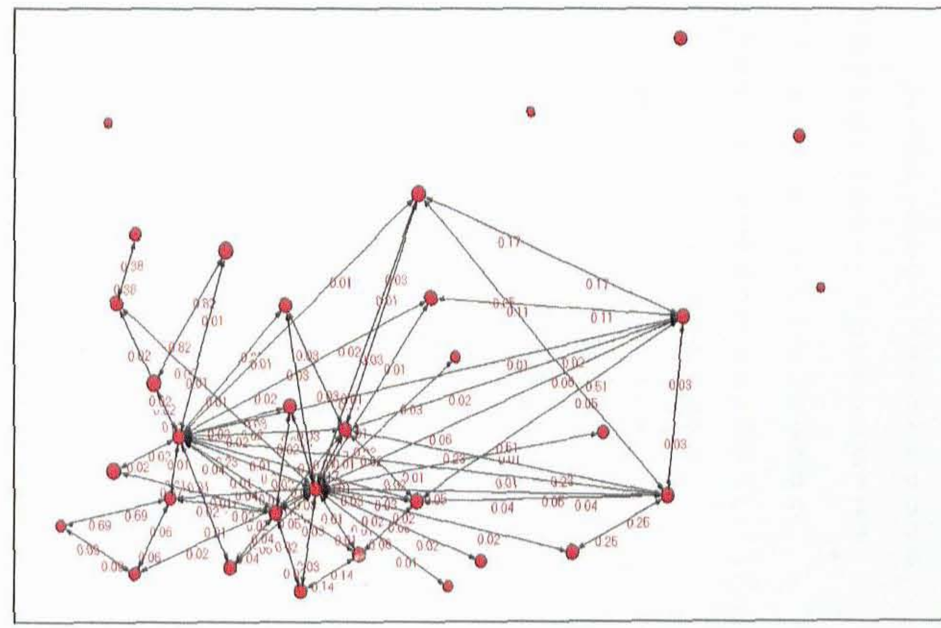


Fig. 7.2: Normalized Co-occurrence of HIV/AIDS and OIS



		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	AIDS	+	0	7	0	0	0	1	0	1	0	0	0	544	2	0	0	0	16	1	1	3	2	2	1	2	0	0	1	0	16	1	1
2	Burkitt's Lymphoma		+	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0
3	Cancer			+	0	0	0	0	0	0	0	0	0	17	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Candidiasis				+	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	Carcinoma					+	0	0	0	0	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
6	Coccidioidomycosis						+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	Cryptococcosis							+	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	Cryptosporidiosis								+	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	Cytomegalovirus									+	0	2	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
10	Encephalopathy										+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	Herpes Simplex											+	0	10	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	Histoplasmosis												+	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	HIV													+	15	0	0	2	16	0	3	18	9	23	0	3	0	1	3	0	198	1	5
14	HTLV														+	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	Immunoblastic Lymphoma															+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	Isosporiasis																+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	Kansasii																	+	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
18	Kaposi's Sarcoma																		+	0	1	0	0	0	0	0	0	0	0	0	1	0	0
19	Leukoencephalopathy																			+	0	0	0	0	2	0	0	0	0	0	0	0	0
20	Lymphoma																				+	0	0	0	0	0	0	0	0	0	0	0	0
21	Mycobacterium Avium Complex																					+	1	1	0	0	0	0	1	0	25	0	0
22	Pneumocystis carinii																						+	15	0	0	0	0	0	0	2	0	0
23	Pneumonia																							+	0	0	0	0	4	0	3	1	0
24	PML																								+	0	0	0	0	0	0	0	0
25	Salmonella																									+	1	0	0	0	0	0	0
26	Shigella																										+	0	0	0	0	0	0
27	Staphylococcus aureus																											+	0	0	0	0	0
28	Streptococcus pneumoniae																												+	0	2	0	0
29	Toxoplasmosis																													+	0	0	0
30	Tuberculosis																														+	0	2
31	Varicella zoster																															+	0
32	Wasting Syndrome																																+

Table 7.8: HIV/AIDS and opportunistic infections: co-occurrence matrix

7.5.4 Co-occurrence of HIV/AIDS and other selected Terms

This section provides an analysis of the co-occurrence of HIV/AIDS' most used acronyms (AIDS, HIV and HTLV) with selected terms such as opportunistic infections, pre-disposing factors, risk factors, sexually transmitted diseases, symptoms and other diseases, in an attempt to find out the relatedness of these factors and diseases to HIV/AIDS in Africa at large, and E&S in particular. It also provides a normalized co-occurrence of words as a measure of the strength of the network (link) ties (whereby the strength (***S***) ranges between 0 and 1).

7.5.4.1 Co-occurrence with Opportunistic Diseases

Figures 7.1 and 7.2 and Table 7.8 present the co-occurrence and relatedness of opportunistic infections and/to HIV/AIDS. The visual maps represent a single large network that consists of AIDS, HIV and HTLV and their inter-linkages with other terms. Outside the networks are terms that were not associated with any of the terms in the network. These include Toxoplasmosis, Isosporiasis, Encephalopathy, Immunoblastic Lymphoma, and Coccidoidomycosis. Although all the terms in the network seem to be associated with one another, some are not directly linked to AIDS, HIV or HTLV.

Table 7.8 provides the co-occurrence frequencies, while Fig 7.2 provides normalized co-occurrence frequencies. AIDS co-occurred with 16 OIs as follows: Kaposi's sarcoma (16, ***S***=0.04), Tuberculosis (16, ***S***=0.02), Cancer (7, ***S***=0.03), Mycobacterium Avium Complex (3, ***S***=0.01), Pneumocystis Carinii (2, ***S***=0.01), Pneumonia (2, ***S***=0.01), Salmonella (2, ***S***=0.02), Cryptococcosis (1, ***S***=0.02), Cytomegalovirus (1, ***S***=0.01), Leukoencephalopathy (1, ***S***=0.02), and Varicella Zoster (1, ***S***=0.02), etc. HIV co-occurred with 19 terms, with the highest co-occurrences stemming from Tuberculosis (198, ***S***=0.17), Pneumonia (23, ***S***=0.06), Mycobacterium Avium Complex (18, ***S***=0.05), Candidiasis (17, ***S***=0.03), Kaposi's sarcoma (16, ***S***=0.03), and Herpes Simplex (10, ***S***=0.03). Others are Pneumocystis carinii (9, ***S***=0.03), Carcinoma (4, ***S***=0.02), Lymphoma (3, ***S***=0.01), Salmonella (3, ***S***=0.02), Streptococcus pneumoniae (3, ***S***=0.01), Kansasii (2, ***S***=0.02), Cryptosporidiosis (1, ***S***=0.01), Cytomegalovirus (1, ***S***=0.01), Histoplasmosis (1, ***S***=0.01), Staphylococcus pneumoniae (1, ***S***=0.02), and Varicella Zoster (1, ***S***=0.01).

Fig. 7.3: Co-occurrence of HIV/AIDS and Pre-Disposing factors

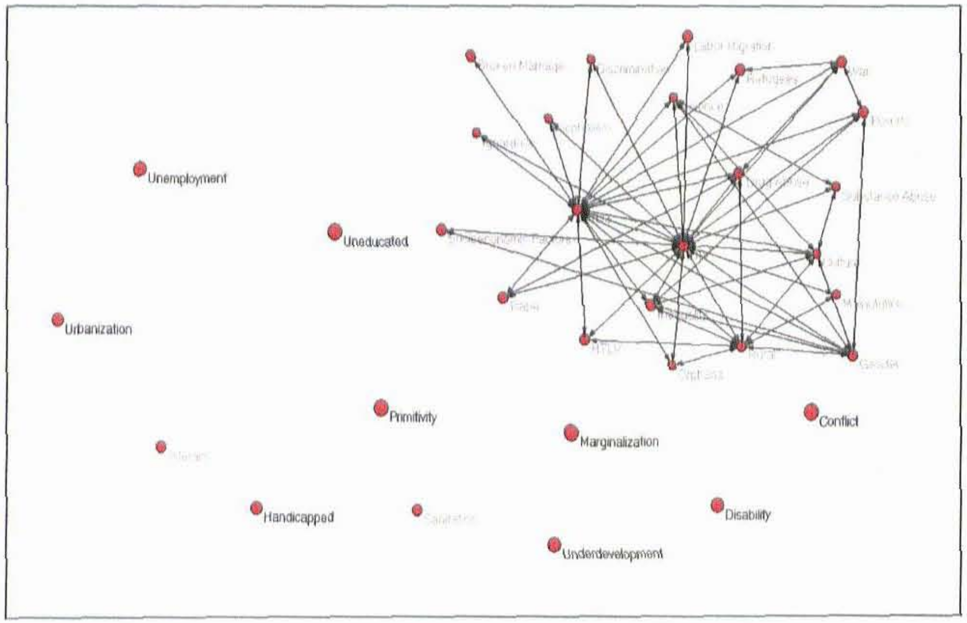
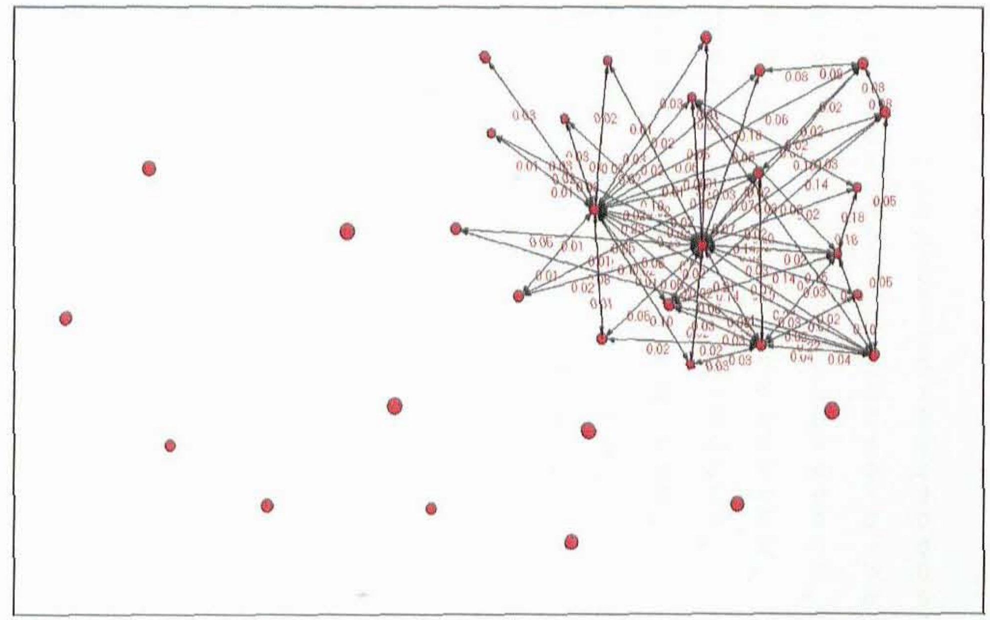


Fig. 7.4: Normalized Co-occurrence of HIV/AIDS and Pre-Disposing factors



		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1	AIDS	+	1	1	0	3	0	2	51	9	0	544	2	1	0	1	2	0	0	27	8	0	2	3	41	0	0	0	0	0	0	0	3	8
2	Alcoholism		+	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Broken Marriage			+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Conflict				+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	Culture					+	0	0	0	2	0	5	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	1	0
6	Disability						+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	Discrimination							+	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	Drug Abuse								+	0	0	51	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
9	Gender									+	0	20	0	0	0	2	0	0	0	0	1	0	0	0	4	0	1	0	0	0	0	0	3	0
10	Handicapped										+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	HIV											+	15	2	0	2	1	0	5	6	6	0	6	6	213	0	7	2	0	0	0	0	11	3
12	HTLV												+	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
13	Ignorance													+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	Illiteracy														+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	Inequality															+	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
16	Labor Migration																+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	Marginalization																	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	Malnutrition																		+	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
19	Orphans																			+	0	0	0	0	4	0	0	0	0	0	0	0	0	0
20	Poverty																				+	0	0	0	0	0	0	0	0	0	0	0	0	1
21	Primitivity																					+	0	0	0	0	0	0	0	0	0	0	0	0
22	Rape																						+	0	0	0	0	0	0	0	0	0	0	0
23	Refugees																							+	0	0	0	0	0	0	0	0	0	1
24	Rural*																								+	0	0	0	0	0	0	0	0	0
25	Sanitation																									+	0	0	0	0	0	0	0	0
26	Socioeconomic Factors																										+	0	0	0	0	0	0	0
27	Substance Abuse																											+	0	0	0	0	1	0
28	Underdevelopment																												+	0	0	0	0	0
29	Uneducated																													+	0	0	0	0
30	Unemployment																														+	0	0	0
31	Urbanization																															+	0	0
32	Violence																																+	0
33	War																																	+

Table 7.9: HIV/AIDS and Pre-Disposing Factors: co-occurrence matrix

7.5.4.2 *Co-occurrence with Pre-Disposing Factors*

Pre-disposing factors are circumstances that may be influencing the spread of HIV/AIDS. These include (a) inadequate formal education (b) lack of clear values, ideals, habits and practices (c) lack of appropriate sex education (d) drug use, abuse and addiction, and (e) an inability to clarify problems and specify goals for proposed change. Others would include all the specific terms that are presented in Fig 7.3 and Table 7.9.

Fig 7.3 and 7.4 reveal that there are several inter-linkages between AIDS, HIV and HTLV and most of the pre-disposing factors, implying that some of these factors may be playing specific roles in the spread of HIV/AIDS. These include Drug Abuse, which co-occurred with AIDS in 51 titles and produced a normalized co-occurrence of ***S***=0.10, followed by Rural-related factors such as development, etc (41, ***S***=0.06), Orphans (27, ***S***=0.10), Gender (9, ***S***=0.04), Poverty (8, ***S***=0.05), and War (8, ***S***=0.06). Other terms that co-occurred with AIDS, as shown in Figures 7.3 and 7.4 and Table 8.9, are Culture (3, ***S***=0.02), Refugees (3, ***S***=0.02), Violence (3, ***S***=0.02), Discrimination (2, ***S***=0.02), Labor Migration (2, ***S***=0.03), and Rape (2, ***S***=0.01). The rest produced one co-occurrence each. On its part, HIV co-occurred with rural-related issues 213 (***S***=0.21) times followed by Drug Abuse (51, ***S***=0.07), Gender (20, ***S***=0.07), Violence (11, ***S***=0.05), and Socioeconomic Factors (7, ***S***=0.05), while Orphans, Poverty, Rape and Refugees produced 6 co-occurrences each with HIV. Of the 32 pre-disposing factors, 11 terms did not have any links with any other term. These were Primitivity, Illiteracy, Unemployment, Sanitation, Handicapped, Uneducated, Disability, Urbanization, Conflict, Underdevelopment (or underdeveloped), and Marginalization.

7.5.4.3 *Co-occurrence with Risk Factors*

Thirty four terms representing the risk factors commonly associated with HIV/AIDS were chosen to conduct a study on the uniqueness of the epidemic in E&S Africa. Five descriptors did not have any inter-linkages, i.e.: Adultery, Heterosexuality, Gonorrhea, Needlestick injury, and Promiscuity.

Fig. 7.5: Co-occurrence of HIV/AIDS and Risk Factors

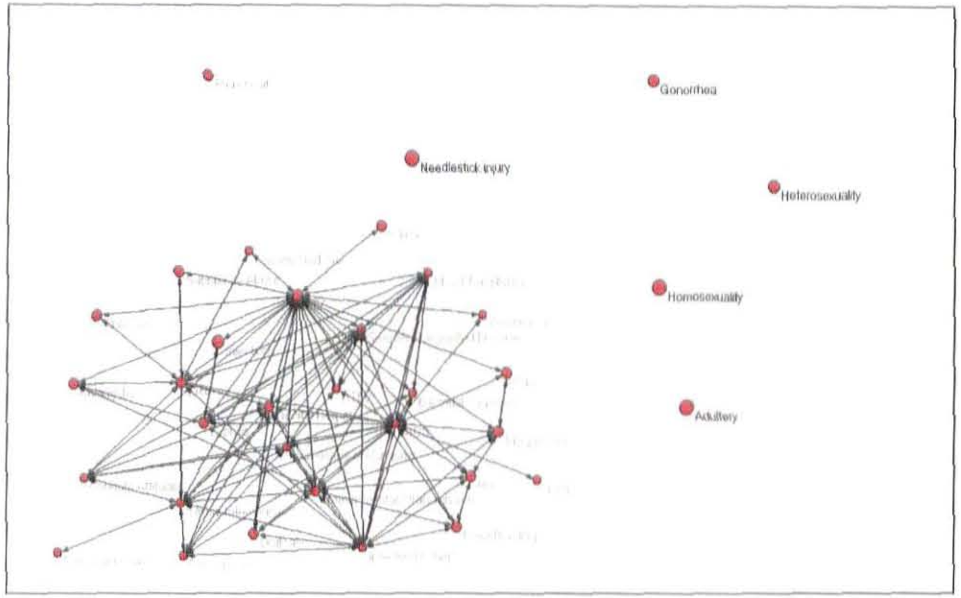
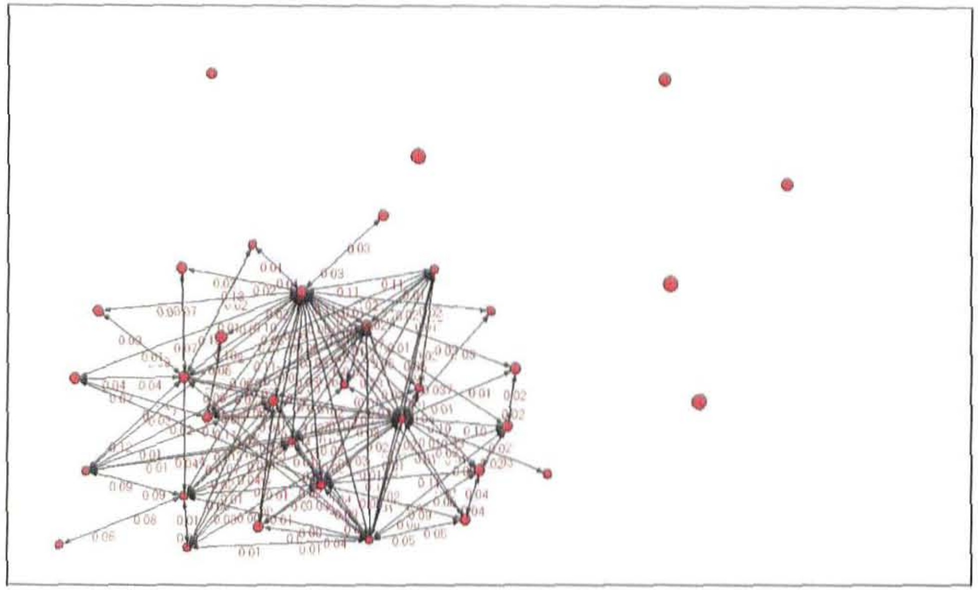


Fig. 7.6: Normalized co-occurrence of HIV/AIDS and Risk Factors



		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
1	Adultery	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	AIDS		+	0	1	4	3	0	1	19	51	0	1	1	0	0	544	1	2	0	10	1	9	0	8	7	0	1	2	0	40	9	0	3	0
3	Anal Sex			+	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Bacterial Vaginosis				+	1	0	0	0	0	0	0	0	0	0	0	15	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0
5	Blood Transfusion					+	0	0	0	0	0	0	0	3	0	0	75	0	1	0	12	0	1	0	0	0	0	0	0	0	1	1	0	2	0
6	Breastfeeding						+	0	0	0	0	0	0	0	0	0	28	0	0	0	5	1	6	0	0	0	0	0	0	0	0	0	0	0	0
7	Chlamydia							+	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
8	Circumcision								+	0	0	0	0	2	0	0	23	0	0	0	1	0	0	0	1	0	0	0	0	0	1	3	0	0	0
9	Condom Attitudes									+	0	0	0	1	0	0	21	0	0	0	0	0	0	0	1	0	0	0	0	0	12	3	0	0	0
10	Drug Abuse										+	0	0	0	0	0	51	0	0	0	5	1	4	0	0	0	0	0	1	0	0	0	0	0	0
11	Extramarital sex											+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
12	Gays												+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	Genital Herpes													+	0	0	26	0	0	0	5	0	1	0	0	1	0	0	0	0	2	3	0	2	0
14	Gonorrhea														+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	Heterosexuality															+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	HIV																+	2	15	4	303	11	128	0	22	34	0	1	6	4	80	78	2	21	1
17	Homosexuality																	+	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	HTLV																		+	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0
19	Injections																			+	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
20	Infected Mothers																				+	6	18	0	12	5	0	0	0	0	1	2	0	3	0
21	Milk																					+	7	0	0	0	0	0	0	0	0	0	0	0	0
22	Mother-to-infant transmission																						+	0	1	1	0	0	0	0	1	0	0	0	0
23	Needlestick injury																							+	0	0	0	0	0	0	0	0	0	0	0
24	Non-usage of Condoms																								+	0	0	0	0	0	2	1	0	0	0
25	Oral Sex																									+	0	0	0	0	0	0	0	0	0
26	Promiscuity																										+	0	0	0	0	0	0	0	0
27	Prostitution																											+	0	0	0	0	0	0	0
28	Rape																												+	0	0	0	0	0	0
29	Saliva																													+	0	0	0	0	0
30	Sexual Intercourse																														+	13	0	0	0
31	Sexually Transmitted Diseases																															+	0	2	0
32	Substance Abuse																																+	0	0
33	Syphilis																																	+	0
34	Unprotected Sex																																		+

Table 7.10: HIV/AIDS and risk factors: co-occurrence matrix

Figures 7.5 and 7.6 and Table 7.10 show that AIDS had co-occurrences with 20 terms, which include (in the order of co-occurrence frequencies and link strengths): Sexual Intercourse (40, ***S***=0.08), Drug Abuse (51, ***S***=0.10), Condom Attitudes (19, ***S***=0.04), Infected Mothers (10, ***S***=0.01), Sexually Transmitted Diseases (9, ***S***=0.02), and Non-usage of Condoms (8, ***S***=0.03), to mention a few. HIV had its highest frequency of co-occurrence with Infected Mothers (303, ***S***=0.26), followed by Mother-to-Infant Transmission (128, ***S***=0.17), Sexual Intercourse (80, ***S***=0.11), Sexually Transmitted Diseases (78, ***S***=0.11), Blood Transfusion (75, ***S***=0.11), and Drug Abuse (51, ***S***=0.07). Others that recorded high frequencies of co-occurrence with HIV were Oral Sex (34, ***S***=0.08), Breastfeeding (28, ***S***=0.08), Genital Herpes (26, ***S***=0.06), Circumcision (23, ***S***=0.07), Non-Usage of Condoms (22, ***S***=0.06), Condom Attitudes (21, ***S***=0.03), Syphilis (21, ***S***=0.06), Bacterial vaginosis (15, ***S***=0.06) and Milk (11, ***S***=0.04). HTLV co-occurred once each with Breastfeeding, Homosexuality, Non-Usage of Condoms, and Sexually Transmitted Diseases.

7.5.4.4 Co-occurrence with Other Sexually Transmitted Diseases

Twenty four names of sexually transmitted diseases, including HIV/AIDS, were analyzed to find out the relationship between them. Fig 7.7 and 7.8 provides visual networks of the terms and their inter-relationships. Stand-alone terms (i.e. terms that are not linked to any other term(s)) include Condylomata Acuminata, Gonorrhea, Lyphogranuloma Venereum, Molluscum Contagiosum, Pediculosis Pubis, Pubic Lice, Scabies and Trichomonal Vaginalis. The co-occurrence frequencies are given in Fig 7.7 and 7.8 and Table 7.12.

The illustrations show that the term AIDS co-occurred with Human Papillomavirus Infection in 13 (0.03) titles, while it co-appeared with the descriptor "Sexually Transmitted Diseases" 9 (***S***=0.02) times. Other co-occurrences involved Hepatitis B (7, ***S***=0.02), Syphilis (3, ***S***=0.01), Bacterial Vaginosis (1, ***S***=0.01) and Genital Warts (1, ***S***=0.003). HIV had more co-occurrences than AIDS with the STDs. It recorded the highest frequency with Human Papillomavirus Infection (144, ***S***=0.09) followed by Sexually Transmitted Diseases (78, ***S***=0.11), Genital Warts (26, ***S***=0.06), Hepatitis B (21, ***S***=0.04), Syphilis (21, ***S***=0.06), Bacterial Vaginosis (15, ***S***=0.06), Herpes Zoster (10, ***S***=0.04), Candidiasis (4, ***S***=0.03), and Granuloma Inguinale (3, ***S***=0.03), etc.

Fig 7.7: Co-occurrence of HIV/AIDS and Other STDs

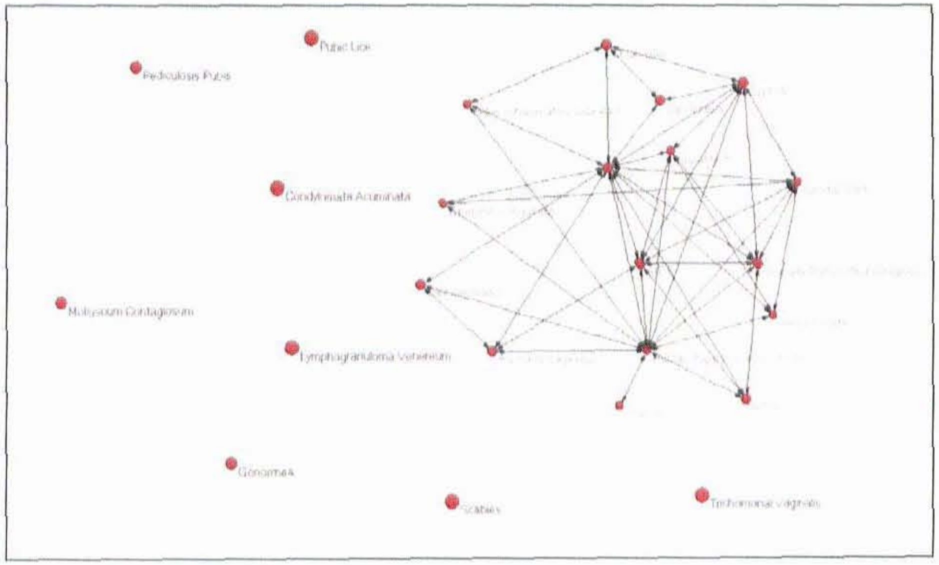
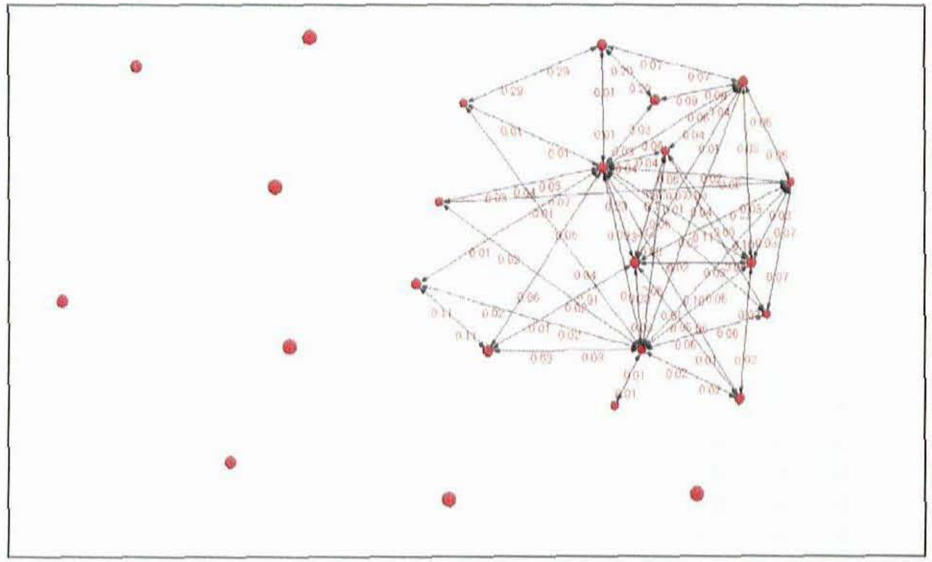


Fig 7.8 Normalized co-occurrence of HIV/AIDS and other STDs



		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	AIDS	+	1	0	0	0	0	1	0	0	7	0	544	2	31	0	0	0	0	0	0	9	3	0	0
2	Bacterial Vaginosis		+	0	0	0	0	0	0	0	0	0	15	0	3	0	0	0	0	0	0	0	0	0	1
3	Candidiasis			+	0	1	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	1	0	0
4	Chancroid				+	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
5	Chlamydia					+	0	0	0	0	0	0	2	0	0	0	0	0	2	0	0	0	1	0	0
6	Condylomata Acuminata						+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	Genital Warts							+	0	1	0	3	26	0	19	0	0	0	0	0	0	3	2	0	0
8	Gonorrhea								+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	Granuloma Inguinale									+	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0
10	Hepatitis B										+	2	21	0	10	0	0	0	0	0	0	3	2	0	0
11	Herpes Zoster											+	10	0	8	0	0	0	0	0	0	0	0	0	0
12	HIV												+	15	144	0	0	0	2	0	0	78	21	0	1
13	HTLV													+	3	0	0	0	0	0	0	1	0	0	0
14	Human Papillomavirus Infection														+	0	0	0	3	0	0	15	3	0	1
15	Lymphogranuloma Venereum															+	0	0	0	0	0	0	0	0	0
16	Molluscum Contagiosum																+	0	0	0	0	0	0	0	0
17	Pediculosis Pubis																	+	0	0	0	0	0	0	0
18	Pelvic Inflammatory Diseases																		+	0	0	0	0	0	0
19	Pubic Lice																			+	0	0	0	0	0
20	Scabies																				+	0	0	0	0
21	Sexually Transmitted Diseases																					+	2	0	0
22	Syphilis																						+	0	0
23	Trichomonal Vaginalis																							+	0
24	Trichomoniasis																								+

Table 7.12: HIV/AIDS and other Sexually Transmitted Diseases: co-occurrence matrix

7.5.4.4 Co-occurrence of HIV/AIDS with Other Diseases

An analysis of the relationship between HIV/AIDS and other diseases (particularly, tropical diseases) is shown in Figures 7.9 and 7.10 and Table 7.13. There were a total of 16 titles (or records) that contained the words AIDS and Tuberculosis, a relationship that produced a normalized co-occurrence of S=0.02, while Hepatitis co-occurred with AIDS in 7 (S=0.02) titles. Other terms that co-occurred with AIDS were Malaria (6, S=0.02), Meningitis (3, S=0.02), Syphilis (3, S=0.01), Leishmaniasis (2, S=0.02), Sickle Cell (2, S=0.05), Cholera (1, S=0.01), and Hypertension (1, S=0.02). HIV had co-occurrences with 11 terms which comprised Tuberculosis (198, S=0.17), Malaria (39, S=0.08), Hepatitis (21, S=0.04), Syphilis (21, S=0.06), Meningitis (15, S=0.05), Malnutrition (5, S=0.03), Leshmaniasis (4, S=0.02), Schistosomiasis (2, S=0.01), Cholera (1, S=0.01), Hypertension (1, S=0.01), and Polio (1, S=0.02). There was no term associated with HTLV.

It was noted that 12 out of 27 terms did not have any linkages. These included Amebiasis, Dengue, Ebola, Giardiasis, Hookworm, Jaundice, Lymphatic Filariasis, Oncocerciasis, Trypanosomiasis, Typhoid and Yellow Fever.

Fig. 7.9: Co-occurrence of HIV/AIDS and other diseases

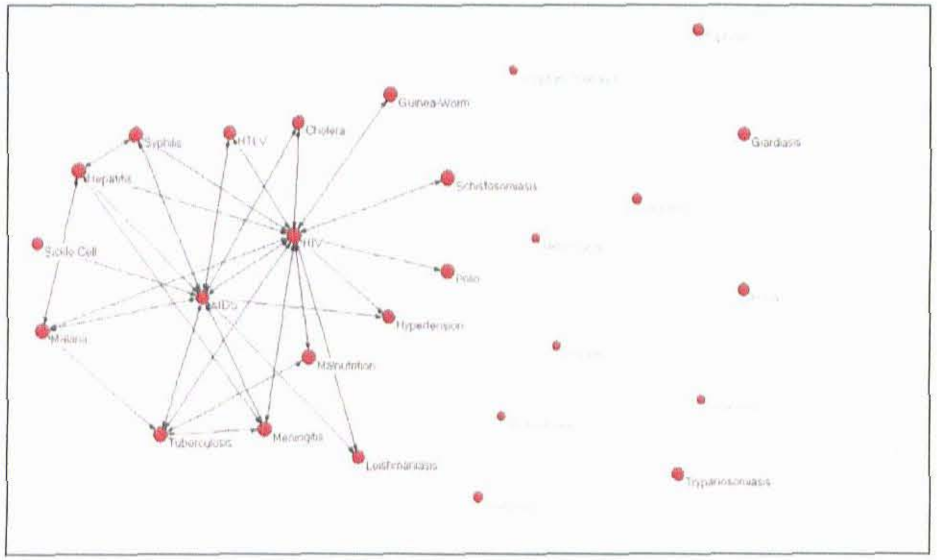
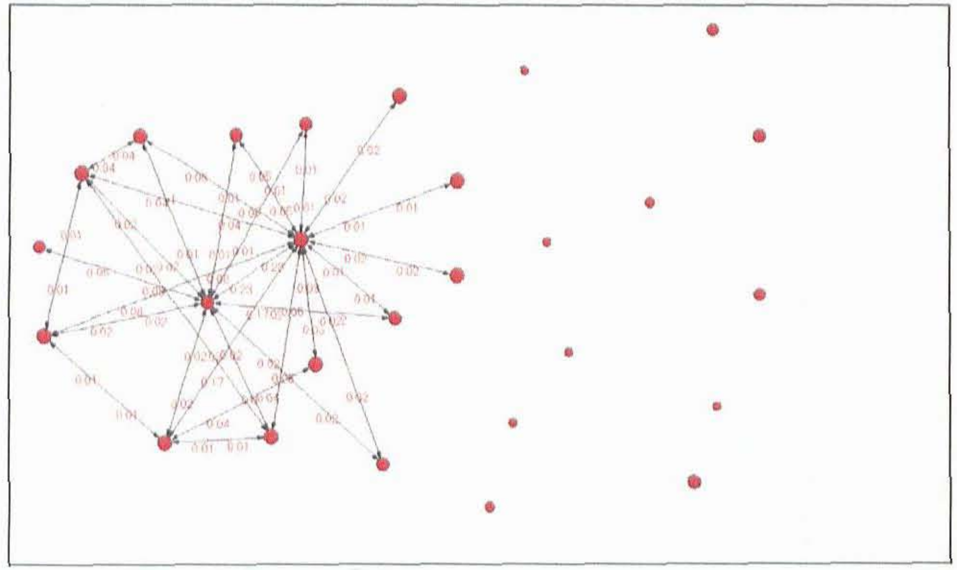


Fig 7.10: Normalized co-occurrence of HIV/AIDS and other Diseases



		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1	AIDS	+	0	1	0	0	0	0	7	544	0	2	1	0	2	0	6	0	3	0	0	0	2	3	0	16	0	0
2	Amebiasis		+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Cholera			+	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Dengue				+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	Ebola					+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	Giardiasis						+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	Guinea-Worm							+	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	Hepatitis								+	21	0	0	0	0	0	0	1	0	1	0	0	0	0	2	0	0	0	0
9	HIV									+	0	15	1	0	4	0	39	5	15	0	1	2	0	21	0	198	0	0
10	Hookworm										+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	HTLV											+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	Hypertension												+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	Jaundice													+	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	Leishmaniasis														+	0	0	0	0	0	0	0	0	0	0	0	0	0
15	Lymphatic Filariasis															+	0	0	0	0	0	0	0	0	0	0	0	0
16	Malaria																+	0	0	0	0	0	0	0	0	2	0	0
17	Malnutrition																	+	0	0	0	0	0	0	0	2	0	0
18	Meningitis																		+	0	0	0	0	0	0	1	0	0
19	Onchocerciasis																			+	0	0	0	0	0	0	0	0
20	Polio																				+	0	0	0	0	0	0	0
21	Schistosomiasis																					+	0	0	0	0	0	0
22	Sickle Cell																						+	0	0	0	0	0
23	Syphilis																							+	0	0	0	0
24	Trypanosomiasis																								+	0	0	0
25	Tuberculosis																									+	0	0
26	Typhoid																										+	0
27	Yellow Fever																											+

Table 7.13: HIV/AIDS and Other Diseases: co-occurrence matrix

7.6 Discussions of the findings

Evidently, there has been an exponential growth in the number of subject terms as illustrated in Table 7.1. From only 68 terms in 1980-1982, the number of terms increased by 3111.7% to 2184 in 2001-2003. The only notable exception is the decrease in the number of terms by about 12.91% from 2184 in 2001-2003 to 1902 in 2004-2005. Seemingly, the growth of the subject headings is associated with the increase in the number of records as indicated in Table 7.1. As the number of records increased, so did the number of terms, and even when the number of records decreased in 2004-2005, the number of terms followed suit. However, the number of publications alone could not have caused an increase in the number of terms, especially if those publications had addressed the same issues or topics. This therefore means that the publications must have addressed different topics over time. New publications may have brought in new ideas, hence the growth of subject headings. Significantly, therefore, the growth of terms, which in part stems from the growth of ideas, means growth of knowledge in the subject domain.

Another factor that may have contributed to the continued growth of terms is the variety of professionals that have come to be involved in HIV/AIDS research. HIV/AIDS is increasingly becoming a multidisciplinary topic. In a study conducted by Onyancha (2006), professionals who were involved in HIV/AIDS research in South Africa between 1986 and 2005 were drawn from a variety of disciplines, which included theology, psychology, educational psychology, health studies, medical sciences, social anthropology, sociology (or social sciences), and nursing. In addition the author, while analyzing records by the subject areas of study, found that most HIV/AIDS research originated from the Medical sciences which yielded 195 (22.49%) records, followed by Psychology (173 or 19.95%), Education (76 or 8.77%) and Social work (72 or 8.30%). Sociology, Health Sciences and Religion were ranked 5th, 6th and 7th equaling 59 (6.81%), 56 (6.46%), and 49 (5.65%), respectively. Others – with 10 or more projects and in descending order – included Business Administration (33), Law (26), Communication Science (19), Anthropology (15), and Economics (12). In total, HIV/AIDS research originated from 41 disciplines or subjects. It is assumed that each professional would use different approaches and ideas relevant to his/her area of research to conduct a study in HIV/AIDS, thereby introducing new ideas from his/her field of specialization to HIV/AIDS research.

Perhaps this may explain the continued growth of subject headings used to describe HIV/AIDS literature which simultaneously reflect a variety of disciplines utilizing HIV/AIDS research.

Regarding the number of terms per paper, the current study witnessed a mixed pattern of growth in which the average number of terms rose from 14.11 in 1980-1982 to 14.61 in 1983-1985, only to decrease to 13.75 in 1986-1988. The figure stood at 14.30 in 1989-1991 and rose steadily in the course of the next two year periods to stop at 16.17 in 1995-1997. The average number of terms thereafter fell to 15.63, and then increased to 15.92 in 2001-2003. A further increase to 16.48 in 2004-2005 was observed. Similar observations were made by Bierbaum & Brooks (1995). In their explanation of the pattern, the authors opined that the variances in indexing intensity may have been due to "*changes in literature (such as greater complexity of individual articles) or to a greater depth and thoroughness*" although, as they observed, such arguments were not apparent from the data (Bierbaum & Brooks, 1995:533).

A trend analysis of the subject content analysis over time as outlined in section 7.7.2 provides an insight into the important or main focus areas of research as reflected in HIV/AIDS papers during specific time periods. Through an analysis of AIDS literature, several writers have observed the explosive growth and astonishing development of the field (Bierbaum et al., 1992; Macias-Chapula et al., 1999). This study's findings reveal that whereas the epidemic was first clinically diagnosed and given the name "Acquired Immunodeficiency Syndrome" in 1982 (Begley, Check, Wingert & Conway, 2001; Konforti, 2001; National Institute of Allergy and Infectious Diseases [NIAID], 2003; Self, Filardo & Lancaster, 1989), it was not until 1983 that it was used as a MESH indexing term (Macias-Chapula et al, 1999). In 1980-1982, the highest ranking subject headings were Burkitt Lymphoma, Antibodies (bacterial and viral) and Human Herpesvirus 4. Hepatitis was also a subject of research during 1980-1982. According to a study conducted by Small & Greenlee (1990:171) on the co-citation of AIDS research, the only cluster that was formed in 1981, "*although not concerned with AIDS, dealt with the problems that arise when the immune system is suppressed by cancer therapy*". The 1981 cluster, according to the authors, consisted of papers on opportunistic infections experienced by cancer patients such as *pneumocystis carinii pneumonia*. Table 7.2 supports this view. Again, the absence of HIV/AIDS-related descriptors may be attributed to the fact that the disease was diagnosed in October 1982. Thus, the name was still new. Seemingly, some time elapses between the coinage of a term and its inception. In their study entitled "*Newspaper Coverage of SARS: A Comparison among Canada, Hong Kong, Mainland China*", Chan, et al (2002) opine that researchers normally take some time to understand a phenomenon before identifying a name for it. Literature review reveals that there were two aspects that were the focus of research between 1980 and 1982 (Small & Greenlee, 1990). These include infection in cancer patients, and the AIDS discovery.

The 1983-1985 year period ushered in a new era of research that was dedicated to understanding the AIDS epidemic and its relationship with other viral infections. It is natural that upon the discovery of an epidemic such as AIDS, the immediate response involves discovering its characteristics and cause before embarking on attempts at eradication. Perhaps the high ranking status of terms such as Kaposi's sarcoma, Retroviridae Infections, Adolescence, Homosexuality, viral antibodies, viral antigens, etc may explain the aforementioned activities. Other notable entrants were other sexually transmitted diseases such as Chlamydia and opportunistic diseases (cytomegalovirus infections), which featured in the AIDS literature, implying a close link between these infections and AIDS during the disease's early years.

The cause of HIV/AIDS, i.e. Human Immunodeficiency Virus, was a major area of research in 1986-1988, as illustrated in Table 7.4. The MESH terms associated with HIV such as HIV seropositivity, HIV antibodies, HIV and HIV Infections emerged from nowhere (so to speak) to join the top ten most used descriptors. The subject headings ranked 2nd, 5th, 6th and 7th, respectively. Seemingly, the focus had shifted from the definition of AIDS, to its cause. However, Acquired Immunodeficiency Syndrome still remained at the top of the Table. Among other areas that attracted researchers' attention, were the risk factors associated with HIV/AIDS, presented in Table 7.4 with the emergence of terms such as "Risk Factors"(position 16), "Prostitution" (position 16), and "Sexual behavior" (position 18).

The quick rise of "HIV Infections" from 7th in 1986-1988 to 2nd in 1989-1991 was also observed. Acquired Immunodeficiency Syndrome still maintained its first position. Another observation that can be drawn from Table 7.5 is that risk factors were still the subject of research. The MESH terms "Sexual behavior", "Risk Factors", and "Prostitution" improved their rank status (except for "Prostitution" which dropped) while "Pregnancy Complications, Infectious" was introduced into the list of 30 top ranking MESH terms. Particular attention was given to AIDS-related opportunistic infections. The emergence of "Tuberculosis", "Tuberculosis, Pulmonary", and "AIDS-Related Opportunistic Infections" attests to the shift in HIV/AIDS research. This may mean that research emphasis had shifted to the means of controlling the causal factors of deaths associated with HIV infected persons, i.e. opportunistic infections.

The quick rise of "HIV Infections" resulted in the MESH term heading the list of the 30 top ranking MESH descriptors in 1992-1994 and thereafter. "Acquired Immunodeficiency Syndrome" switched positions with "HIV Infections" to come 2nd between 1992 and 2005 as shown in Table 7.6. HIV-1, a descriptor that emerged in 1989-1991 to rank 5th, came 4th in 1992-1994 and 1995-1997, and 3rd in 2001-2003 and 2004-2005. The absence of other types of HIV (i.e. HIV-2) was noted. Adolescence (or adolescent) is a term that maintained high visibility throughout the entire period of study, perhaps because young people are the most vulnerable, and prevention and control measures are targeted at this age group. Studies have shown that more than half of those newly infected with HIV are between 15 and 24 years old (United Nations Development Programme and Centre for African Family Studies as cited in Onyancha & Ocholla, 2006). It is estimated that 11.8 million young people are living with HIV/AIDS. Whether the pattern of research on adolescents or adolescence was influenced by the high incidence rate of the disease among the youth was hard to derive from the data. Terms that are related to HIV/AIDS drugs have also emerged in the recent past, which again probably heralds a shift in research. These terms include Anti-HIV agents; Nevirapine: Anti-Retroviral Therapy, Highly Active: Anti-retroviral Agents; Zidovudine; HIV Envelope Protein gp 120; AIDS Vaccines; Drug Industry; and Molecular Sequence Data. Most of these terms emerged in 1998-2000.

Concerning research sub-fields, Table 7.7 provides a list of 32 HIV/AIDS subheadings that received attention from researchers between 1983 and 2005. The sub-topics fall under three categories, namely, (1) the most researched (2) moderately researched and (3) least researched areas. The most researched sub-topics (sub-fields) of HIV/AIDS include epidemiology, prevention & control, transmission, complications, and drug therapy. Each of these terms yielded over 500 postings. The second category consisted of immunology, diagnosis, virology, psychology, mortality, economics, therapy, blood, ethnology, and etiology. Finally, the least researched sub-fields of HIV/AIDS include physiopathology, nursing, microbiology, pathology, genetics, classification, metabolism, congenital, parasitology, history, radiology, surgery, rehabilitation, urine, cerebrospinal fluid, diet therapy, and ultrasonography. Reading the Table from left to right, it was evident that epidemiology, prevention and control, transmission and complications of the HIV/AIDS disease have dominated the scene since the beginning of the epidemic. The researchers' concern can therefore have been said to involve the epidemiological aspects of the disease. Similar findings were reported in Latin America and the Caribbean (LAC) region (Macias-Chapula et al, 1999). However, a few subheadings that appeared in this study among the topmost ranked (e.g. complications, diagnosis, therapy, drug therapy, and psychology) did not emerge as important areas of research in the LAC region's study. The pattern of research in different subfields of HIV/AIDS that were observed by Small & Greenlee (1990) was, in many parts, similar to those found in this study. For instance, the authors noted that in 1981, the key concern of the researchers lay in finding the possible cause of immune suppression and two factors were suspected, notably, cytomegalovirus (CMV) and Herpes virus. Again, the authors observed that by 1983, research was focused on the clinical description of the AIDS disease in addition to the possible origin and cause of the epidemic. One of the fields utilizing HIV/AIDS then was immunology. Finally, the authors' observation that most papers published in 1984 were dedicated to research on homosexual populations and various opportunistic infections was also found true in this study. Comparatively, and in many respects, Small & Greenlee's findings were similar to those found in this study.

A co-word analysis of HIV/AIDS and the opportunistic diseases (see Fig 7.1 and 7.2 and Table 7.8) produced patterns that could be said to support arguments that some of the opportunistic infections' association with HIV/AIDS in Africa is stronger than in industrialized nations or other geographic regions. As seen in Table 7.8 and Fig 7.1 and 7.2, HIV/AIDS was associated with 21 opportunistic infections. These were led by Tuberculosis, followed by Pneumonia, Mycobacterium Avium Complex, Cancer and Kaposi's sarcoma. This revelation supports medically documented findings which claim that Tuberculosis is the most common ailment in HIV-infected persons in Africa. Cohen (2000b) states that Tuberculosis kills more HIV-infected persons in Africa than any other AIDS-related disease. He further argues that the disease is rare in AIDS patients in the United States and Europe. He reports that one neurologist and pathologist found no TB in all 390 autopsies that they performed on people who had died from AIDS. Other opportunistic infections such as Pneumocystis Carinii Pneumonia (PCP) are more common in HIV-infected persons in developed countries. Cohen (2000b) claims that PCP infected more than 80% of the AIDS patients in developed countries in the 1980s, while only 8% of the HIV-infected people autopsied in Africa were found to have had PCP. A few diseases did not have any connection with HIV/AIDS in Africa, as illustrated in Figs 7.1 and 7.2 and Table 7.8. These were Toxoplasmosis, Isosporiasis, Encephalopathy, Immunoblastic Lymphoma, and Coccidoidomycosis. Some of these opportunistic infections (OIs) are missing from the list of the most commonly associated OIs with HIV/AIDS in the study the same authors conducted in 2005 (Onyancha & Ocholla, 2005) perhaps because that study was international in nature, a fact that most probably supports the view that HIV/AIDS differs from one geographic region to another. In general terms, the study identified *candidiasis, cytomegalovirus, herpes simplex viruses, mycobacterium avium complex, pneumocystis carinii pneumonia, toxoplasmosis, and tuberculosis* as most commonly associated with HIV/AIDS. Their strengths of association were as follows: *Pneumocystis carinii* (***S***=0.014641), *Cytomegalovirus* (***S***=0.00603), *Mycobacterium avium-intracellulare* (***S***=0.004331), *Toxoplasma* (***S***=0.001876), and *Cryptococcus neoformans* (***S***=0.000504). *Mycobacterium Tuberculosis* had a strength of association of ***S***=0.000483, while Herpes posted an ***S*** value of ***S***=0.000328.

Concerning the predisposing factors, the findings in Figures 7.3 and 7.4 and Table 7.9 illustrate some association between several factors and HIV/AIDS in E&S Africa. Factors that could be influencing the spread of HIV/AIDS in the region include culture, substance or drug abuse, malnutrition, rural-related factors and activities, violence, rape or forced sex, labor migration, ignorance, broken marriages, poverty, inequality, socioeconomic factors, refugees and war. The most influencing factors were rural and drug or substance abuse related, a fact illustrated by their high frequency and strength of co-occurrence and association with HIV/AIDS. Most of these factors should be subjects of concern in intervention programs.

Another factor that this study considered in investigating the uniqueness of HIV/AIDS in Africa is the co-occurrence of AIDS-related risk factors with HIV/AIDS descriptors within the titles of HIV/AIDS papers. With the exception of five terms, all the other 26 terms were associated with HIV/AIDS descriptors, either directly or by proxy (Fig. 7.5 and 7.6 and Table 7.10). The terms that did not have any links with HIV/AIDS are: adultery, gonorrhea, heterosexuality, promiscuity, and needlestick injury. Their non-co-occurrence with HIV/AIDS terms should not be misconstrued, however, to mean that these risk factors are not in anyway related to HIV/AIDS. The authors of HIV/AIDS papers probably used related terms or their variants. It should be noted that most of the risk factors are sex-related. Perhaps, this may be attributed to the fact that HIV/AIDS is mainly contracted through sexual intercourse, especially between different sexes (i.e. heterosexually) in the case of Africa, as observed by Cohen (2000b). Overall, the most commonly HIV/AIDS-associated risk factors are sexual intercourse; vertical transmission (mother to child during birth), blood transfusions and contaminated needles (intravenous drug use, needle stick injuries). According to the findings in Fig. 7.5 and 7.6 and Table 7.10, several AIDS-related risk factors, including the above, were associated with HIV/AIDS in E&S Africa. The highest co-occurrence between HIV/AIDS and the risk factors was recorded by "infected mothers", followed by a closely related descriptor, "mother-to-infant transmission". Sexual intercourse and sexually transmitted diseases also ranked highly. The descriptor "Contaminated needles" was less common.

One of the risk factors (and sometimes a pre-disposing factor) associated with HIV/AIDS is that of sexually transmitted diseases. Amuyunzu-Nyamongo (2001) argues that individuals with ulcerative STIs have an increased risk of HIV infection by factors of two to four times. Figs. 7.7 and 7.8 and Table 7.12 reveal co-occurrence patterns between the names of various sexually transmitted diseases and HIV/AIDS. Of all the sexually transmitted diseases, Papillomavirus Infection was the most common in HIV/AIDS titles. It recorded a co-occurrence and strength of association frequency of 144 and 0.09 with HIV, and 13 and 0.03 with AIDS, respectively. There were other high co-occurrence frequencies with genital warts, hepatitis B, syphilis, bacterial vaginosis, and herpes zoster. Seemingly, HIV/AIDS is mainly linked to un-curable STDs. For instance, the *human papilloma virus* is thought to be one of the main causes of cervical cancer, and has been linked to other types of cancers of the female reproductive system. While this virus can be treated to reduce signs and symptoms, it does not yet have a cure. Both Hepatitis B and Herpes virus are further examples of STD's that do not yet have cures. Diseases or viruses that have cures co-occurred less frequently with HIV/AIDS, implying that they are rarely associated with the epidemic in E&S Africa.

The effect of other diseases on HIV-infected persons was also considered by analyzing the relationship between HIV/AIDS and the selected diseases through term-co-occurrence analysis. It has long been observed that HIV/AIDS does not actually kill; rather it is the opportunistic infections/diseases (or other diseases) that kill AIDS patients (Me´decins Sans Frontie`res, 2003). This study sought to identify the most common HIV/AIDS-associated diseases, especially tropical diseases. Out of the total 24 diseases, slightly over one-half (½) co-occurred with HIV/AIDS. The highest frequency of co-occurrence was recorded by tuberculosis, which is said to be killing more HIV-infected persons in Africa than any other disease (Cohen 2000b). Other terms that were linked to HIV/AIDS descriptors include cholera, guinea-worm, hepatitis, hypertension, leishmaniasis, malaria, malnutrition, meningitis, polio, schistomiasis, sickle cell, and syphilis. Although most of these diseases have no direct link with HIV/AIDS, it is common knowledge that most have an equally (if not greater) negative impact on the economies of E&S Africa and its peoples. For instance, Malaria is said to be killing millions of people in the region. The World Health Organization (2004) estimates that Malaria accounts for more than a million deaths per year, of which about 90% occur in tropical Africa.

Again, it has been observed that HIV infection increases the incidence and severity of clinical Malaria and although the effect of Malaria on HIV is not well documented, UNICEF (2003) states that acute Malaria infection increases viral load. The relatedness of other diseases such as cholera and polio to HIV/AIDS may be attributed to the fact that all are diseases of poverty. The reasons for the co-occurrence of HIV/AIDS and some of the diseases were, however, not very clear. Perhaps researchers were curious to discover the relationships between these diseases, or simply wanted to find out the impact the diseases have in E&S Africa.

7.7 Summary

This Chapter sought to examine the subject content of HIV/AIDS research on E&S Africa in order to distinctly expose the efforts made in various sub-fields of HIV/AIDS research and to find out the influence of selected aspects that are related to HIV/AIDS in Africa on the disease. In order to fulfill this purpose, the Chapter examined: the growth of HIV/AIDS subject indexing terms (MESH terms); the most commonly used MESH terms in indexing HIV/AIDS literature; the publishing activity in the sub-fields of HIV/AIDS; and the most commonly associated opportunistic infections, pre-disposing factors, risk factors, sexually transmitted diseases, and other tropical diseases, with HIV/AIDS in E&S Africa.

The findings show that the number of subject indexing MESH terms has increased remarkably since 1980. The terms grew from just 127 in 1980-1982, to 25524 in 2001-2003 and dropped slightly to 17124 in 2004-2005.

An analysis of the most commonly used terms to index HIV/AIDS literature shows a turbulent period in the 1980s and early 1990s. Some of the most commonly used terms then include *Burkitt Lymphoma*; *Antibodies, Bacterial*; *Antibodies, Viral; Herpesvirus, Human; Sarcoma, Kaposi; Retroviridae Infections; Adolescence;* and *Antibodies, Viral* (14), etc. Although some of these terms prominently featured up until the late 1990s, the introduction of HIV/AIDS-specific descriptors obscured their dominance, particularly between 1992 and 2005. During this period, the terms showed stability in their rankings, with *HIV Infections; Acquired Immunodeficiency Syndrome; HIV-1; Adolescence; Pregnancy Complications, Infectious; Anti-HIV Agents, etc.* becoming the most commonly used terms.

The top ranking sub-topics of HIV/AIDS literature were, in descending order, *Epidemiology, Prevention & Control, Transmission, Complications, Drug Therapy, Immunology, Diagnosis, Virology, Psychology* and *Mortality*, etc.

The following diseases and factors produced high/strong co-occurrence patterns with HIV/AIDS:

- Opportunistic infections: *Tuberculosis, Pneumonia, Kaposi's sarcoma, Herpes Simplex, Candidiasis, Mycobacterium Avium Complex, etc*
- Pre-disposing factors: *Rural*-related issues, *Drug abuse, Orphans, Gender, Violence, etc.*
- Risk factors: *Infected Mothers, Mother-to-infant transmission, Sexual intercourse, Drug abuse, Oral sex*, and *Breastfeeding*
- Sexually transmitted diseases (infections): *Human Papillomavirus Infection, Sexually Transmitted Diseases, Genital Warts, Hepatisis B, Syphilis,* and *Bacterial vaginosis, etc.*
- Other diseases: *Tuberculosis, Malaria, Hepatitis, Syphilis, Meningitis, etc.*

Notably, the choice of the terms used to conduct a co-word analysis largely influenced the results presented in the whole of section 7.5.4. It is possible that some terms (e.g. synonyms, related terms, etc) which were left out may have been used by authors. It is also true that the authors' choice of terms when formulating article titles (i.e. research topics) differs from author to author. This analysis was also limited to HIV/AIDS articles written by and/or about E&S Africa. An analysis of the articles written by and/or about other countries – which could have provided a comparative study on the uniqueness of HIV/AIDS in Africa – was not conducted, again due to time constraints. Nevertheless, the analysis of data, as reported in this Chapter, provides results that can assist to draw informed conclusions.

The next Chapter (Chapter Eight) provides a summary of the findings and the conclusions drawn from these results. It also provides recommendations based on the findings.

CHAPTER EIGHT

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

8.1 Introduction

HIV/AIDS has devastatingly spread to all the corners of the world, and nowhere is its impact felt more than in Sub-Saharan Africa, which is home to about 25 million HIV infected people. The disease has so far claimed over 2 million lives in the region to date. Eastern and Southern Africa are among the worst hit regions in Sub-Saharan Africa. This has called for concerted efforts from all professionals to curb the further spread of the disease, and find a means of eradication. Informetricians in developed countries have joined hands with their colleagues in other disciplines to render information-related approaches in the war against HIV/AIDS, thus supporting decision-making processes in those countries. This is particularly necessary in the case of intervention programs and research. Informetric studies are rare in Sub-Saharan Africa therefore hampering decision making processes geared towards fighting HIV/AIDS in the region.

This study sought to broadly examine research output and the scientific impact of HIV/AIDS research as produced by and about E&S Africa between 1980 and 2005, and as reflected in three key bibliographic databases, namely, MEDLINE, Science Citation Index and Social Sciences Citation Index.

In order to fulfill the above purpose, four broad objectives were formulated. The four objectives formed the foundation for data presentation and interpretation as outlined in Chapters four to seven

8.2 SUMMARY OF THE FINDINGS BY OBJECTIVES

This section provides a summary of the findings in accordance with the four broad objectives. The summary is largely informed by specific research sub-questions in each of the four Chapters.

8.2.1 To examine the nature, trend and type of HIV/AIDS research collaboration in E&S Africa in order to recommend ways of improving or strengthening such collaborative activities

- A trend analysis of both single- and multiple-author papers revealed a continued growth rate in both categories, with single-author papers increasing at a higher rate than multiple-author papers. Each country produced more multiple-author papers than single-author papers, and South Africa led the pack with a total of 440 single-author papers and 1870 multiple author papers. Uganda was second with 135 and 989 single- and multiple-author papers, respectively, followed by Kenya, Tanzania, Zambia, Malawi, etc. Multiple-author papers were the majority in each country throughout the period of study.

- Two approaches were used to measure the degree and extent of collaboration, i.e.
  a. The ratio (expressed as percentage) of single- and multiple- author papers to the total number of papers that provided information on the authors
  b. The ratio of multiple-author papers to the total number of papers in each country, commonly referred to as collaboration coefficient (CC)

  In the first instance, single-author papers were less than multiple-author papers for all countries. Each country's multiple-author papers accounted for over 70% of the total papers with known authors. With regard to the second measurement of the degree and extent of collaboration (i.e. collaboration coefficient), multiple-author papers accounted for over 75% of the total number of papers in each country, except for Botswana, which recorded a CC of 0.70. The highest CC (0.92) was yielded by Somalia, followed by Ethiopia (0.91), Angola (0.90), Tanzania (0.90), Kenya (0.89), Malawi (0.89) and Zimbabwe (0.89).

- Three types of collaboration were identified. Most countries collaborated domestically (among E&S African countries), regionally (with other African countries) and internationally (with countries outside Africa) (see Table 4.7).

International collaboration was the most common. The distribution pattern of country collaborations with each of the E&S African countries, according to the number of collaborating countries, was as follows (in the order of Domestic, Regional, International): Angola (0,0,4), Botswana (9,3,15), Djibouti (0,1,1), Eritrea (0,0,1), Ethiopia (5,1,24), Kenya (8, 11, 37), Lesotho (6, 1, 9), Malawi (10, 2, 22), Mozambique (3, 1, 16), Namibia (6,0,5), Somalia (0,1,3), South Africa (12,12,51), Sudan (1,1,9), Swaziland (7,1,10), Tanzania (8,5,32), Uganda (7,8,38), Zambia (5,14,28), and Zimbabwe (11,7,27). The heavy reliance on international collaboration has been attributed to the fact that authors in less developed countries largely rely on their foreign counterparts in publishing their research findings. The pattern may also be attributed to the nature of research funding. For instance, foreign-based research funding may dictate that the funding country (donor) provide a researcher to join the research team in the developing country, mainly to monitor the use of the research funds and assist with other activities such as technical services, etc.

- Collaborating authors, institutions and countries were identified. Co-authorship between Plummer FA and Ndinya-Acholla registered the highest number of papers (i.e. 46) followed by Wawer MJ and Serwadda D (44), Gray RH and Serwadda D (43), Wawer MJ and Gray RH (42), Richardson BA and Kreiss JK (39), Overbaugh J and Kreiss JK (38) and Mandaliya K and Kreiss JK (38), etc. The top ranking collaborating institutions were UNIV NAIROBI and UNIV WASHINGTON (426), UNIV NAIROBI and UNIV MANITOBA (248), HARVARD UNIV and MUHIMBILI UNIV (222), JOHNS HOPKINS UNIV and MAKERERE UNIV (213) and FRED HUTCHINSON CANC RES CTR and UNIV WASHINGTON (189). The distribution pattern of country co-authorship was analyzed per country of study focus. The highest international country co-authorship pattern was recorded between South Africa and the USA (352), followed by Uganda and the USA (284), Kenya and the USA (280), South Africa and England (231), Kenya and Canada (156), Tanzania and the USA (154), Malawi and the USA (138), Kenya and England (129), Malawi and England (122), Zambia and England (114), Zambia and the USA (109), and Uganda and England (124). Regional co-authorship (in descending order of the number of co-authored papers) was as follows: Kenya and Cameroon (9), Kenya and Zaire (8), Cameroon and Zambia (7), South Africa and Cote D'Ivoire (6) and Sudan and Egypt (6). South Africa and Zimbabwe topped the list in the regional collaboration category with 20 co-authored papers, followed by Kenya and South Africa (12), South Africa and Zambia (12), Malawi and South Africa (12), Kenya and Tanzania (12), Kenya and Uganda (11), and Kenya and Zambia (11). The high pattern of collaboration was therefore recorded by researchers and institutions from industrialized countries such as the USA, Great Britain, Belgium, Switzerland and Australia. Contributing factors may include the same reasons offered above. Institutional collaboration was mainly among the universities, implying collaboration between academies and between the lecturers/supervisors/study leaders and students.

❖ Author networks have increased in number and grown in composition since 1981. There were three two-author networks that met the set citation thresholds between 1981 and 1985. This number grew to 11 networks in 1986-1990 at the following thresholds: citation (c) of 2, co-citation (cc) of 2 and co-citation coefficient (ccv) of 0.15. 1991-1995 yielded 15 author networks at the thresholds of c=3, cc=3 and ccv=0.15, while there were 16 and 18 author networks in 1996-2000 and 2001-2005, respectively, with thresholds of c=4, cc=4, and ccv=0.15 (for 1996-2000) and c=5, cc=5 and ccv=0.15 (for 2001-2005. The networks varied in composition, with some networks consisting of as few authors as 2, and the largest comprising as many as 48 authors. There were several instances when authors shifted from one network to another in the period of study. Fig. 4.9 provides a map of 16 networks produced by authors for the entire period of study, i.e. 1981-2005. The thresholds were set at c=7, cc=7 and ccv=20. The geographic areas of study/research consisted of Uganda, Kenya, Ethiopia, South Africa, Malawi, and Zambia. The complexity and cost of HIV/AIDS research may be contributing to the growing number of author networks as well as the large number of authors involved in a research project.

8.2.2 To examine the growth, productivity and scientific impact of HIV/AIDS sources of information [source publications] as they relate to E&S Africa between 1980 and 2005 in order to assess the visibility and coverage of HIV/AIDS sources in three key bibliographic databases; and to provide relevant information so as to assist information providers, users in general, and more specifically, collection development librarians, particularly in the two regions, in their decision making processes regarding the identification, selection and development of relevant HIV/AIDS resources.

- Ulrich's Periodical Directory yielded a total of 1393 serials that are produced in the 18 E&S African countries. South Africa led with 916, followed by Kenya (113), Zimbabwe (78), Tanzania (48), and Malawi (40), etc. When analyzed according to various categories, academic/scholarly serials were the majority (i.e. 546), followed by Newsletters/Bulletins (278), Trade/Business-to-Business (271), Consumer (257), and Newspapers (205). Out of these, only 14 were covered in MEDLINE while ISI indexed 28 (24 in SCI, and 4 in SSCI) as of February 2006. It should be noted that South Africa is well endowed with resources (especially financial resources) that have enabled her to be the most productive in terms of the number of serials, which usually require heavy capital investment. Most countries in the region cannot afford to publish as many serials.

- An analysis of the papers by document type provided a partial pattern regarding the most commonly used source publications to publish HIV/AIDS papers. It was observed that journal articles were the majority. MEDLINE yielded 4770, while ISI produced 5082 journal articles. Meeting abstracts numbered 265, and newspaper articles were 189 in MEDLINE. Others included Case Reports (175) and Book reviews (21), implying that HIV/AIDS information is published in and disseminated through a variety of sources. The dominance of journal articles could mean that authors value the importance of publishing their research findings in journals. This may be due to the fact that journal articles are highly regarded in rating researchers (especially university lecturers), particularly as regards their recruitment, promotion and tenure.

- All countries recorded exponential growth rates in the number of sources that publish HIV/AIDS literature produced by and on E&S Africa as indexed in both the MEDLINE and ISI databases. From just 3 sources that published HIV/AIDS literature on Uganda, 2 on Ethiopia, and 1 each on Kenya, Tanzania, Malawi, and Sudan in 1980-1982 (as reflected in MEDLINE), the number of sources has grown significantly. For instance, by 2001-2003, HIV/AIDS literature specific to South Africa was published in 221 (MEDLINE) and 271 (ISI) sources. The distribution pattern for other countries during the same period was as follows, in the order of MEDLINE, ISI: Uganda (75, 117), Kenya (72, 84), Tanzania (48, 91), Zimbabwe (39, 90), Zambia (38, 68) and Malawi (40, 66), etc. This pattern of growth may have been caused by a variety of researchers involved in HIV/AIDS research which dictate the publication of the research findings in various sources that cover different disciplines. High productivity of HIV/AIDS papers may have also contributed to the introduction of new sources to publish those papers.

- The distribution of sources according to foreign countries of publication produced the following pattern in MEDLINE: USA (299), Great Britain (223), Netherlands (31), Switzerland (23), Germany (22), Denmark (19), France (16), Canada (14), Ireland (12), and Norway (11). The most productive foreign countries in ISI were the USA (320), Great Britain (270), Germany (35), Netherlands (34), France (20), Denmark (19), Ireland (14), Switzerland (13), Canada (10) and Australia (8). In the regional countries of publication category, South Africa led with 16 and 14 sources in MEDLINE and ISI, respectively, followed by Kenya (4, 2), Zimbabwe (2, 1), Nigeria (2), Malawi (2), Egypt (2), Ethiopia (1), and Uganda (1). It has been indicated in section 5.4.1 that the USA and the United Kingdom respectively publish almost 40 and 12 times the number of serials published in E&S Africa. It is not surprising therefore to note that the USA and Great Britain are the most commonly used geographic regions for publishing HIV/AIDS research about E&S Africa. The two regions have a number of quality source publications. It has also been observed that domestic/regional writers prefer to publish their papers through international collaboration, a situation that may demand that these papers are published in the foreign author's country of origin.

- There were a total of 804 MEDLINE-indexed and 823 ISI-indexed sources that published HIV/AIDS literature as produced by and on E&S African countries. The 10 most productive sources in MEDLINE include the following, in descending order of their productivity: S AFR MED J (457), AIDS (442), LANCET (422), J ACQUIR IMMUNE DEFIC SYNDR (212), AIDS ANAL AFR (164), EAST AFR MED J (157), J INFEC DIS (147), AIDS RES HUM RETROVIRUSES (130), AIDS CARE (119) and BRIT MED J (109). In the case of ISI, the following were the most productive sources: AIDS (633), LANCET (297), S AFR MED J (273), J INFEC DIS (228), EAST AFR MED J (220), INT J TUBERC LUNG DIS (180), AIDS RES HUM RETROVIRUS (172), J ACQ IMMUN DEFIC SYND (171), INT J STD AIDS (135), and TRANS ROY SOC TROP MED HYG (128).

- Among the sources that published HIV/AIDS papers on E&S Africa, the NEW ENGL J MED had the highest impact factor (i.e. 38.57) followed by NATURE (32.182), SCIENCE (31.853), NATURE MED (31.223), JAMA (24.831), LANCET (21.713), J EXP MED (14.588), J CLIN INVEST (14.204), J NATL CANCER INST (13.856), and ANN INTERN MED (13.144). There are a number of factors that influence the scientific impact of a source. These include the frequency of publication, the journal's popularity, the publisher's reputation, the ease with which authors' access the journal, and the internationalism of a journal, etc. All or any of these factors may have contributed to the pattern of IF witnessed in this study.

- The most cited sources by HIV/AIDS authors were used to identify the most commonly used sources by researchers. The frequency of their occurrence in the HIV/AIDS papers' references was used to compute their citation frequencies. The top ranked sources included AIDS (11576), LANCET (9492), J INFEC DIS (4802), NEW ENGL J MED (4093), J VIROL (2960), J ACQ IMMUN DEF SYND (2847), JAMA (2688), AIDS RES HUM RETROV (2198), SCIENCE (2150), BRIT MED J (2121). It was noted that the majority of the most commonly used sources were health or medical journals, which explains the pattern of usability of the sources since HIV/AIDS is largely regarded a medical problem. There are high chances that all researchers, at some point, would use a medical journal as a reference when conducting HIV/AIDS research. It should also be noted that researchers made use of popular science magazines, such as *Science*, which usually report current research activities.

- Most of the sources belonged to *Medical Sciences*, which yielded 488 and 462 sources in MEDLINE and ISI, respectively. Others included (in the order of MEDLINE, ISI) *Biology* (81, 101), *Public Health and Safety* (32, 31), *Pharmacy and Pharmacology* (18, 23), *Business and Economics* (18, 20), *Psychology* (16, 22), *Nutrition and dietetics* (11, 14), *Chemistry* (10, 13), *Education* (8, 12), and *Social Services and Welfare* (12, 8). A further analysis of the *Medical Sciences* category's papers yielded the following pattern: *Medical Sciences (General)* (132, 138), *Communicable Diseases* (72, 44), *Obstetrics and Gynecology* (27, 26), *Allergology and Immunology* (24, 29), and *Oncology* (25, 21), etc. *Medical sciences* sources were the most productive, implying the high reliance of researchers on these sources to publish HIV/AIDS research, most probably because HIV/AIDS, just as many sexually transmitted diseases, is a medical and health problem.

- Using publications count, the core sources totaled 8 in MEDLINE and 9 in ISI. MEDLINE's core sources are S AFR MED J, AIDS, LANCET, J ACQUIR IMMUNE DEFIC SYNDR, AIDS ANAL AFR, EAST AFR MED J, J INFECT DIS, and AIDS RES HUM RETROVIRUSES while ISI's core sources include AIDS, LANCET, S AFR MED J, J INFECT DIS, EAST AFR MED J, INT J TUBERC LUNG DIS, AIDS RES HUM RETROVIRUS, J ACQ IMMUN DEFIC SYND, and INT J STD AIDS. A citation-based analysis produced 13 core sources, namely, AIDS, LANCET, J INFECT DIS, NEW ENGL J MED, J VIROL, J ACQ IMMUN DEF SYND, JAMA, AIDS RES HUM RETROV, SCIENCE, BRIT MED J, S AFR MED J, SOC SCI MED, and J CLIN MICROBIOL.

8.2.3 To evaluate the performance of individual authors, institutions and countries in terms of their productivity and scientific impact in order to: (a) identify the most prolific and influential researchers, countries and institutions that conduct HIV/AIDS research in and about Eastern and Southern Africa and (b) compare the productivity and scientific impact of domestic/regional authors, institutions, and countries with their foreign counterparts.

- Both regional and foreign countries contribute to HIV/AIDS research in E&S Africa. The distribution pattern according to the number of contributing countries within each sub-regional country was as follows: South Africa (13), Zimbabwe (13), Kenya (12), Malawi (12), Tanzania (12), Botswana (11), Uganda (11), Ethiopia (10) and Zambia. Regional (i.e. countries from the rest of Africa) distribution produced the following pattern: Tanzania (17), South Africa (16), Uganda (14), Kenya (13), Zambia (13), and Zimbabwe (12). International country contributors were distributed as follows: South Africa (56), Kenya (46), Uganda (44), Tanzania (39), Zambia (35), Malawi (31), and Zimbabwe (31), etc. The region has therefore witnessed the contribution of a number of countries in HIV/AIDS research, a fact that may be attributed to the regions' high prevalence rates and the world's concern about ever increasing cases of HIV/AIDS.

- In the regional countries category, South Africa was the most productive with a total of 2189 papers, followed by Kenya (843), Uganda (717), Tanzania (540), Malawi (487), Zambia (407), Zimbabwe (400), Ethiopia (243), and Botswana (109). The USA topped the list of foreign countries with 2429 papers, followed by England (1412), Switzerland (365), the Netherlands (349), Canada (336), France (279), Belgium (246), and Sweden (235), etc. Overall, the most productive countries include (in the order of MEDLINE, ISI) the USA (2209, 2679), Great Britain (2123, 2116), South Africa (609, 560), France (122, 213), Kenya (168, 163). Canada (199, 27), Netherlands (124, 99), Switzerland (105, 96), Denmark (66, 60) and Zimbabwe (107, 18). The reasons that could have led to this pattern of productivity are: the presence of non-governmental international organizations in a country; donor funding that is geared towards HIV/AIDS research and intervention programs; a country's policy on research and development; how well developed a country's education (especially tertiary education) is; and a country's research units, etc. In addition, the high pattern of performance on the part of foreign countries could be attributed to the existence of African students and professionals residing or working in those countries and who would find it convenient to conduct research on a country they know well, i.e. their country of birth..

❖ The most productive regional institutions were UNIV WITWATERSRAND (460), UNIV NAIROBI (425), UNIV KWAZULU NATAL (381), UNIV CAPE TOWN (331), MAKERERE UNIV (287), UNIV ZIMBABWE (237), MINIST HLTH (206), UGANDA VIRUS RES INST (196), UNIV STELLENBOSCH (165), and KENYA GOVT MED RES CTR (160). In the foreign institutions category, the CTR DIS CONTROL & PREVENTION led with a total of 252 papers, followed by JOHNS HOPKINS UNIV (241), LONDON SCH HYG & TROP MED (236), WHO (207), UNIV WASHINGTON (206), HARVARD UNIV (184), UNIV MANITOBA (175), COLUMBIA UNIV (159), UNIV LIVERPOOL (159), and CASE WESTERN RESERVE UNIV (127), among others. Seemingly, universities are the most productive institutions. This lends credence to the argument that universities, being the highest level of education, comprise of well endowed resources (i.e. human and information resources as well as research facilities such as laboratories, etc) which, in our view, have enabled universities to perform better than other institutions. Governments and the industry frequently engage the services of academics to conduct research on a given topic.

❖ The most prolific authors include the following (in the order of ISI, MEDLINE): Plummer FA (147, 106), Ndinya-Achola JO (144, 99), Whitworth JAG (107, 100), Bwayo, JJ (103, 94), Kreiss JK (113, 68), Coovadia HM (102, 70), Hayes RJ (97, 63), Gilks CF (85, 62), Harries AD (99, 47), and Serwadda D (72, 67), etc. Author productivity is largely influenced by the author's personal characteristics (e.g. intelligence, achievement, personality, expectations) and the author's environment or situation (e.g. colleagues, availability of information, the problem under investigation, author's field or discipline) (O'Connor & Voos, 1981:13). Some or all of these could have caused the production variances witnessed in this study.

- ❖ Two approaches were used to study each author's influence. The first approach was an analysis that studied the references of ISI's papers' in order to determine the most cited author by HIV/AIDS researchers in the region. Subsequently, an analysis of the total number of citations of HIV/AIDS papers was used to determine each author's international impact. In the first instance, the most cited authors by HIV/AIDS researchers in the region were Wilkinson D (462), Grosskurth H (428), Harries AD (381), Gilks CF (359), Wawer MJ (355), Coutsoudis A (299), Fawzi WW (263), Plummer FA (285), Taha TET (250), and Temmerman M (244). In the second instance, Plummer FA led with 6639 cites, followed by Ndinya-Achola JO (5909), Kreiss JK (4093), Bwayo JJ (3734), Hayes RJ (3228), Miotti PG (2205) and Wawer MJ (2171). Plummer FA yielded the highest average impact (i.e. 45.16 cites per paper), followed by Miotti PG (45.00), Wawire-Mangen F (42.83), Ndinya-Achola JO (41.91) and Grosskurth H (41.49).

- ❖ The ten most cited works were: Grosskurth H et al. [1995] which received 740 citations followed by Guay LA et al. [1999] (519), Cameron DW et al. [1989] (477), Quinn TC et al. [2000] (471) and Plummer FA et al. [1991] (451), Flemming DT and Wasserheit JN [1999] (394), Simpson GR et al. [1996] (392), Simonsen JN et al. [1988] (340), Greenblatt RM et al. [1988] (281) and Lucas SB et al. [1993] (273). It was observed that almost all of these works were authored not only through collaboration between two or more authors, but also through international collaboration, which would help explain why they received the most citations. International collaboration increases a paper's average citation impact by a higher margin than that of domestically published papers. Additionally, the results in Chapter four reveal that whereas single-author papers increase the average impact by 3.48 citations per paper, multiple author papers supercede this with an average of 12.75 citations per paper. The citedness of papers also depends on factors such as the language of publication, the availability of the papers, ease of access to journals containing the papers, researchers' retrieval skills, and journal coverage in ISI databases (Garfield, 1993:325).

- ❖ The purpose of conducting a trend analysis of papers vis-à-vis that of citations was two-fold, namely, to compare the growth of papers and citations over time and to compare the cited and uncited papers throughout the period of study. From just 24 citations from 3 papers in 1983, the number of citations has increased to the current cumulative 72450 citations from 6367 papers. Except for a few instances where the number of papers decreased, the growth of papers has also shown an upward trend and pattern. There were a total of 1667 uncited papers between 1980 and 2005, while the cited papers totaled 4700. The uncited papers accounted for 26.2% of the total number of papers. The uncitedness of papers may have been caused by several factors, some of which have been highlighted above. Garfield (1993:325) also points out that uncitedness may be due to the language of publication, unavoidable and even appropriate duplication or replication, a delayed recognition of premature ideas, the relative visibility of a journal, or an inadequate use of information retrieval services by authors and referees, to name a few.

8.2.4 To examine the subject content of HIV/AIDS research on E&S Africa so as to (a) distinctly bring out the efforts made in various sub-fields of HIV/AIDS research and (b) to find out the influence of selected aspects that are related to HIV/AIDS in Africa on the disease. As a result it sought to fulfill the following specific objectives.

- ❖ The number of subject indexing MESH terms increased from just 127 in 1980-1982, to 25524 in 2001-2003, and dropped slightly to 17124 in 2004-2005. An analysis of the average number of terms per paper showed a mixed growth rate during the entire study period. The exponential growth of terms, as illustrated in Chapter seven, was associated with an increase in the number of papers, which may imply that newly published papers addressed new ideas. Secondly, it has been shown in previous studies (e.g. Onyancha, 2006) that HIV/AIDS research is increasingly becoming a multidisciplinary topic, thus attracting professionals from different disciplines, resulting in different terms that describe the literature of HIV/AIDS.

- The top indexing MESH terms in 1980-1982 included: *Burkitt Lymphoma* (9); *Antibodies, Bacterial* (7); *Antibodies, Viral* (5); and *Herpesvirus, Human* (5), etc. *Acquired Immunodeficiency Syndrome* led in 1983-1985 with 29 postings, followed by *Sarcoma, Kaposi* (22), *Retroviridae Infections* (15), *Adolescence* (15), and *Antibodies,* and *Viral* (14), etc. The distribution pattern of the terms in 1986-1988 was as follows: *Acquired Immunodeficiency Syndrome* (172), *HIV Seropositivity* (38), *Antibodies, Viral* (36), *Adolescence* (34), *HIV Antibodies* (32), and *HIV* (30), etc. The 1989-1991 period produced the following pattern: *Acquired Immunodeficiency Syndrome* (407), *HIV Infections* (262), *HIV Seropositivity* (127), *Adolescence* (114), *HIV-1* (103), *Sexual behavior* (63) and *Risk Factors* (63), etc. Throughout the 1980s, the terms displayed turbulent patterns, changing the positions in their rankings. The 1992-2005 ushered in relative stability whereby *HIV Infections* ranked first, followed by *Acquired Immunodeficiency Syndrome; HIV-1; Adolescence; Pregnancy Complications, Infectious; Anti-HIV Agents, etc.* It was observed that HIV/AIDS-specific terms were introduced between 1983 and 1985, a year after the disease's discovery and diagnosis. This was probably because researchers naturally take some time to understand a phenomenon such as a new disease, and take even longer to give the disease a name. During the early 1980s, *Acquired Immunodeficiency Syndrome* was the term most commonly used when indexing HIV/AIDS papers, but this was overtaken by *HIV infections* from the 1990s onwards. This could mean that the focus of research had shifted from the disease itself to its causal factor, i.e. HIV.

- The top sub-topics of HIV/AIDS literature were, in descending order, *Epidemiology* (1986), *Prevention & Control* (1565), *Transmission* (1036), *Complications* (948), *Drug Therapy* (561), *Immunology* (390), *Diagnosis* (377), *Virology* (351), *Psychology* (301) and *Mortality* (289), etc. Seemingly, research appears focused on epidemiology, prevention & control and transmission. Epidemiology, defined as the study of the distribution and determinants of disease and injury in human populations, has drawn the interest of many researchers as a 'soft' research area that can be studied by the majority, unlike more specialized areas such as drug therapy, immunology, diagnosis, or virology, etc. Equally important to researchers are aspects related to prevention and control, which most countries in the developing world are currently emphasizing through intervention programs and prevention and control campaigns.

- The most common opportunistic infections in HIV/AIDS literature included *Tuberculosis, Pneumonia, Kaposi's sarcoma, Herpes Simplex, Candidiasis,* and *Mycobacterium Avium Complex, etc.,* while the top ranking pre-disposing factors comprised *Rural-related issues, Drug abuse, Orphans, Gender, and Violence, etc.* An analysis of the co-occurrence of HIV/AIDS and the risk factors ranked the following risk factors highly: *Infected Mothers, Mother-to-infant transmission, Sexual intercourse, Drug abuse, Oral sex,* and *Breastfeeding.* Sexually transmitted diseases (infections) that had high co-occurrence frequencies included: *Human Papillomavirus Infection, Sexually Transmitted Diseases, Genital Warts, Hepatisis B, Syphilis,* and *Bacterial Vaginosis;* while high ranking tropical diseases were *Tuberculosis, Malaria, Hepatitis, Syphilis, Meningitis, etc.* Notably, most descriptors exhibited strong and close association with HIV/AIDS-specific terms, implying a close relationship.

8.3 CONCLUSIONS

Several conclusions were drawn based on the findings in Chapters four to seven and in line with the study's objectives.

Firstly, HIV/AIDS research in E&S Africa is largely conducted through collaboration, as illustrated by the number of co-authored papers, which accounted for over 70% of the total number of papers in each country discussed in Chapter Four. This may imply a growing recognition for the need and importance of collaborative research in Africa. Most countries in the region may have realized that research collaboration is inevitable, and thus may be encouraging and even demanding collaborative research. Research collaboration between the E&S African countries is minimal when compared to the collaboration between these and foreign countries (i.e. countries outside Africa). Country-wise collaboration in HIV/AIDS research is therefore largely between regional countries (E&S African countries) and foreign countries. Even within the international country-collaborators category, HIV/AIDS research collaboration is skewed in favor of the USA and Great Britain. It was also observed that collaboration between E&S African countries and the rest of Africa is almost non-existent, with the countries in West Africa recording a comparatively higher pattern than North African countries. Seemingly, language and geographical proximity influence research collaboration in Africa. It was also noted that institutional collaboration is mainly between universities. Nevertheless, industry-university collaboration was visible, particularly between government laboratories, ministries or teaching hospitals and the universities, which to a large extent are responsible in the day-to-day running of the hospital teaching facilities/programs in most countries. Apart from South Africa, which recorded a high pattern of internal collaboration (collaboration between South African institutions), HIV/AIDS research collaboration is mainly between institutions based in E&S African countries and those based in foreign countries. Notably, there has been a remarkable growth in the number of HIV/AIDS researchers' networks between 1980 and 2005. The composition of these networks shows a high pattern of collaboration between local and foreign researchers. Finally, it was observed that research collaboration increases the average impact by 12.75, while research conducted by a single researcher increases the average impact by only 3.48.

Secondly, regarding the analysis of sources, it was noted in Chapter Five that the coverage of sources published in E&S African countries in key bibliographic databases is minimal. Out of the total 1393 serials that are published in E&S Africa, only 14 (1.01%) are covered in the MEDLINE database, 23 (1.65%) in SCI and 4 (0.29%) in SSCI. When calculated as a percentage of the total number of scholarly/academic journals (which totaled 546), the coverage distribution in the three databases is: MEDLINE: 2.56%, SCI: 4.21% and SSCI: 0.73%. Sources that publish HIV/AIDS research on E&S Africa are evenly distributed in the MEDLINE and ISI databases, although about 50% of the total research output is unique in each database, a situation that may prove problematic with regard to database subscription. It was also observed that journals are the most commonly used sources and channels in publishing and disseminating HIV/AIDS research on E&S Africa. The second most preferred source and channel, is that of newspapers. It should be borne in mind, however, that there is a lot of research on HIV/AIDS that is published in and disseminated through grey literature and newspapers which are usually not indexed in mainstream indexing services. Another notable observation was that the number of sources publishing HIV/AIDS research on E&S Africa has exponentially increased over the entire period of study, i.e. 1980-2005, thereby posing serious challenges to collection development librarians and researchers/authors. The growth of the sources of publications correlationally implies the growth of knowledge in the subject domain. Sources that publish HIV/AIDS research on E&S Africa are largely published in foreign countries. Out of the total 804 and 823 HIV/AIDS sources in MEDLINE and ISI, respectively, 92.54% and 97.57% were published in foreign countries, while locally published sources accounted for 3.73% and 2.19% in MEDLINE and ISI, respectively. This pattern is likely to restrict developing countries in their decision making processes given that foreign-based journals are not easily accessible due to exorbitant subscription fees. Nevertheless, these articles definitely get international recognition and visibility. It was also noted that most HIV/AIDS research on E&S Africa is published in relatively low impact factor journals. Out of the total 823 sources in ISI, only 11 sources had an impact factor of more than 10.0. HIV/AIDS research on E&S Africa is largely published in medical science-specific source publications, and more specifically, in general medical sources. The core sources of HIV/AIDS research, were AIDS, LANCET, J INFECT DIS, NEW ENGL J MED, J VIROL, J ACQ IMMUN DEF SYND, JAMA, AIDS RES HUM RETROV, SCIENCE, BRIT MED J, S AFR MED J, SOC SCI MED, and J CLIN MICROBIOL.

Thirdly, an analysis of the producers of HIV/AIDS research revealed that a relatively high number of countries have been, or are engaged in, conducting HIV/AIDS research about E&S Africa, as illustrated in Chapter Six. Research is evenly conducted in and/or by foreign countries. Counting the frequencies of occurrence of each country in the address field yielded a sum total of 7041 occurrences for foreign countries, and 6161 for African countries. Most of the research is published in foreign countries, which accounted for approximately 83% and 88% of the total research papers in MEDLINE and ISI, respectively. A similar situation in the analysis of sources was presented in Chapter Five. It was also noted that HIV/AIDS research is largely conducted by or at universities, which is not very unique given that universities have the intellectual resources necessary to conduct and disseminate research, the latter being through publications and seminars/conferences/workshops. Finally, it was shown that the impact of HIV/AIDS research in and about E&S Africa has continued to increase - illustrated by the continued growth of the number of citations between 1980 and 2005. Nevertheless, a relatively large amount of HIV/AIDS research (26.2%) remains uncited.

Fourthly, an examination of the subject content of HIV/AIDS literature in Chapter Seven revealed that the number of the keywords/terms used to index HIV/AIDS research outputs has exponentially grown, thereby providing more options when accessing HIV/AIDS research findings. It was observed that HIV/AIDS-specific terms (i.e. HIV infections and Acquired Immunodeficiency Syndrome) are the major keywords by which HIV/AIDS research findings can be retrieved from the indexing services/databases. Concerning research on the sub-fields of HIV/AIDS research, it was noted that most research that was performed between 1980 and 2005 about epidemiology, prevention & control, transmission, complications, and Drug therapy. Drug therapy and ARVs are quickly emerging as the main areas of HIV/AIDS research, implying that research has shifted from the causal factors and diagnosis (major areas of concern in the 1990s) to the care and treatment for HIV infected persons. A co-word analysis reveals that HIV/AIDS is strongly associated with opportunistic infections, pre-disposing factors, risk factors, sexually transmitted diseases and other tropical diseases that are common in Sub-Saharan African countries. This may imply that HIV/AIDS in Africa is distinct as far as its commonly associated causal/influencing factors and diseases are concerned. However, this observation is not conclusive because it requires a study on the relationship between these terms in other countries (outside Africa) for comparison.

8.4 Recommendations

The study has shown that collaboration is gaining recognition, perhaps as a result of the benefits associated with it. HIV/AIDS research in the region is currently being conducted largely through collaboration. Countries in the region are therefore encouraged to continue supporting collaborative ventures in HIV/AIDS research given that research collaboration increases research impact, among other benefits. They should encourage both internal and international collaboration – the latter being for purposes of international visibility and impact – by [for example] organizing international conferences within E&S Africa during which researchers can exchange ideas, and in so doing, identify researchers from other countries with whom they can collaborate. Conferences can also be held to find out ways of strengthening collaboration in HIV/AIDS research. Conferences have previously been organized and held in order to discover ways and means of strengthening HIV/AIDS research collaboration between the developed countries and Africa. One such conference was organized by the Africa Program of the Center for Strategic and International Studies (CSIS) and the Brookings Institution's Center on the United States and France (CUSF); to find ways of strengthening U.S.-French collaboration on HIV/AIDS in Africa. The aim was to identify new opportunities for active collaboration between France and the United States in combating HIV/AIDS in Africa. The focus areas included the importance of HIV/AIDS to U.S. and French foreign policy and security assessments, the disease's likely destabilizing impact on African states, the role of the Global Fund to fight AIDS, TB, and Malaria, and the need for closer collaboration between U.S., French, and African researchers, policy makers, and program implementers. It was noted that local participation was highly necessary in order for any successful research collaboration effort to take place (Morrison & Gordon, 2001). These initiatives may also provide forums through which researchers can identify others with whom they can collaborate.

The coverage of HIV/AIDS sources published in Africa in the MEDLINE and ISI databases is minimal, and whether this is attributable to indexing bias on the part of the indexing services, or the poor quality of African sources could not be derived from the analyzed data. However, since the indexing services highly regard those journals with high international impact, it can be inferred that journals that are published in the region do not meet the quality standards set by the indexing services. This calls for a re-assesment of the journals' editorial policies, among other issues. Secondly, most journals that are gaining popularity are electronically available, and this perhaps explains why some African journals, which are largely available in print, are not easily internationally visible - a fact that affects their impact. We recommend that these journals be published online (on the Internet) for wider circulation, visibility and impact. This researcher concurs with Rosenberg when she advises that in order for African journals to "*compete successfully with journals published* *elsewhere, they need to offer access to full text online*" (Rosenberg, 2002, Summary section, para. 1). Thirdly, it is recommended that countries in the region endeavor to create regionalized bibliographic databases that can be used for evaluating research. South Africa has done well in this regard through SABINET (South African Bibliographic and Information Network). SABINET is a database aggregator that makes available a wide number of online databases, mostly bibliographic, but including some fulltext databases. The database specialises in South African content, but also provides access to international databases. Its main focus areas include:

- **Information Access** – by obtaining full-texts of the best or most frequently requested local content. It offers access to online references, abstracts, and full-text documents, supported by electronic document procurement, and an alerting service;
- **Library Support** - through library acquisitions and cataloguing, interlending, and retrospective conversion; and
- **Information Management** – with specialist consultation, support, electronic publishing, and software.

Noting that SABINET has a lot of potential, it is strongly advised that the database producers consider building a citation index similar to the ISI's citation indexes for research evaluation purposes. Other countries in E&S Africa should emulate South Africa and create national bibliographic databases, for the same purposes as SABINET's.

It was observed that a large percentage of research findings are published in foreign sources and countries. Although this pattern is healthy as far as international visibility and the impact of HIV/AIDS research conducted in and about Africa is concerned, it nevertheless denies policy and decision makers in Africa free access to the research findings that were specifically meant to improve health standards in their respective countries. In order to allow international visibility and impact, as well as provide free access to the findings, it is highly recommended that authors/researchers be encouraged by way of incentives to present the findings in regionalized conferences, and publish them in both print and electronic conference proceedings while publishing the papers in foreign sources. Another option is to publish their papers through Open Access (OA) platforms. The University of Maryland (2004) opines that with Open Access, works are created with no expectation of direct monetary gain and made available at no cost to the reader on the Internet for the purposes of education and research. OA therefore permits users to read, download, copy, distribute, print, search, or link to the full texts of works, crawl them for indexing, pass them as data to software, or use them for any other lawful purpose, without financial, legal, or technical barriers other than those inseparable from gaining access to the Internet itself. This may seem to be an infringement of the author's copyright. But according to the Unievrsity of Maryland (2004: para 3-4):

> "*Authors own the original copyright in their works. In the process of publishing, authors can transfer to publishers the right for publishers to post the work freely on the Web, or authors can retain the right to post their own work on institutional or disciplinary servers. They (authors) [do] retain control over the integrity of their work and have the right to be properly acknowledged and cited*".

Institutional repositories are other avenues through which researchers can disseminate their research findings without infringing copyright laws.

It was also noted that countries that publish the majority of source publications were the most productive (as authors) in terms of the number of HIV/AIDS papers. This may mean that HIV/AIDS research is conducted by African authors who reside in foreign countries, or foreign authors who have an interest in the HIV/AIDS situation in the region. Further research is, however, recommended in order to determine the authors' nationality (country of origin). This generally act as an indicator of the knowledge transfer and sharing processes which are very vital in solving complex phenomena.

Although uncitedness does not mean uselessness, the high pattern of uncitedness of HIV/AIDS research about E&S Africa can generate concern about the quality of research. It has been observed that authors cite previous works for a number of reasons (Wallace, 1989: Cronin in Kings, 1987). But it is also true that uncited papers could have been found to be insignificant in terms of its contribution in theory development, introduction of new ideas, etc in a subject domain. Again, papers may be uncited because they are not known to other researchers. In this respect, we recommend publication of research findings in quality Open Access (OA) journals.

This study was meant to be as comprehensive as possible, but due to time constraints, some areas could not be covered and therefore it is recommended that:

- A co-citation analysis of HIV/AIDS literature on E&S Africa be conducted using the ISI data in order to compare the results with those in Chapter Seven regarding the emerging areas of HIV/AIDS research in the region.
- Other bibliographic databases e.g. SABINET, EMBASE, etc. be used to conduct further bibliometric/informetric studies so as to defuse ISI's and MEDLINE's alleged bias in their indexing of papers originating from the USA and Great Britain.
- Other research methods such as surveys (e.g. using questionnaires, etc) be carried out in order to validate the current study's results as regards the African countries' HIV/AIDS research productivity. This approach will also distinguish between domestic and foreign author productivity and may also yield correct results on author productivity.
- A study be conducted in order to find out why authors prefer to publish in foreign sources.
- Further research is also recommended to ascertain why most journals that are published in Africa are not covered in the MEDLINE and ISI databases.
- A co-word analysis be conducted to check for strengths of association between HIV/AIDS and the descriptors of opportunistic diseases, pre-disposing factors, risk factors, sexually transmitted diseases and other diseases as subject headings. The findings can then be compared to the findings in Chapter Seven in order to draw correct conclusions on the uniqueness of HIV/AIDS in Africa

There is a need to conduct a study on newspapers and magazines which are said to be publishing a lot of biomedical research (Lewison, 2001). We concur with Lewison's (2001:185) recommendation that bio-medical bibliometricians/informetricians make use of newspapers in conducting bibliometric studies because:

- they are cheap, readily available and normally change little between editions;
- they are widely read and their readership is well characterised both socially and geographically;
- the citing articles have many of the characteristics of a scientific paper, e.g. author, title, and length of paper; and
- the cited sources are usually reasonably identifiable.

Finally, in order to conduct meaningful bibliometric/informetric analyses, the following issues need to be addressed:

- The need for major database publishers, such as ISI, to offer special subscription rates to institutions in developing countries. For instance, they could make their products available to these institutions at affordable rates so that researchers in these countries have a chance to carry out similar bibliometric studies, knowing that ISI's databases are the most commonly used science indicators. It is worth noting that this researcher had to travel from Kenya to South Africa in order to collect data.

- It was observed that the MEDLINE database does not provide authors' addresses in its back files. Hence, it is recommended that all database publishers should consider providing full bibliographic details of articles and brief biographical information on the authors of those articles indexed in their databases. This is essential because bibliometric analyses are based on these details.

- It was difficult to determine the author's country of affiliation since authors' names in the AU field in ISI databases do not correspond with the institutional affiliations in the C1 (authors' institutional affiliations field). It is therefore recommended that ISI endeavours to correspond an author's name with his/her institutional affiliation in order to enable productivity comparisons between regional and foreign authors, and identify regional authors.

REFERENCES

Afolabi, M. (1989). The literature of Onchocerciasis 1960-1981. *International Library Review*, 21(4), 487-493.

Aizawa, A., & Kageura, K. (2003). Calculating association between technical terms based on co-occurrences in keyword lists of academic papers. *Systems and Computers in Japan*, 34(3), 85-95

Amuyunzu-Nyamongo, M. (2001). HIV/AIDS in Kenya: Moving beyond policy and rhetoric. *African Sociological Review*, 5(2)

Anderson, J., MacLean, M., & Davis, C. (1996). Malaria research: an audit of international activity. London: The Wellcome Trust.

Arunachalam, S., & Gunasekaran, S. (2001). Cardiovascular diseases research in India and China in the 1990s. In: M. Davis & C. S. Wilson (eds.). *Proceedings of the 8th International Conference on Scientometrics and Informetrics*, Sydney, 16-20 July 2001, 1, 53-62.

Aznar, A. (2002). Definition of a general communication strategy for the media on HIV/AIDS in East Africa. Retrieved April 1, 2004, from http://www.aids-africa.org/Documents/Aids%20Day%20Press%20Release.htm

Baake, K. (2006). The role of secondary research. Retrieved July 23, 2006, from http://www.faculty.english.ttu.edu/baake/Spring_06/lit_rev.htm

Baldwin, C., Hughes, J., Hope, T., Jacoby, R., & Ziebland, S. (2003). Ethics and dementia: Mapping the literature by bibliometric analysis. *International Journal of Geriatric Psychiatry*, 18, 41-54

Basu, A., & Aggarwal, R. (2001). International collaboration in India and its impact on institutional performance. *Scientometrics*, 52(3), 379-394

Batagelj, V. & Mrvar, A. (2006). Pajek: Program for analysis and visualization of large networks: Reference manual: List of commands with short explanation, version 1.15. Retrieved July 31, 2006 from http://vlado.fmf.uni-lj.si/pub/networks/pajek/doc/pajekman.pdf

Bazeley, P. (1998). Peer review and panel decisions in the assessment of Australian Research Council project grant applicants: What counts in a highly competitive context? *Higher Education,* 35, 435-452

Beattie, P., Renshaw, M., & Davis, C. S. (1999). Strengthening health research in the developing countries: Malaria research capacity in Africa. Retrieved January 25, 2003, from http://mim.nih.gov/english/achievements/i2318.pdf

Begley, S., Check, E., Wingert, P., & Conway, F. (2001). AIDS at 20. *Newsweek,* 137(24), 34

Behrens, S. J. (2000). *Bibliographic control and information sources* (3rd ed.). Pretoria: UNISA Press.

Bensman, S. J. (1985). Journal collection management as a cumulative advantage process. *College and Research Libraries,* 46(1), 13-29

Bierbaum, E. G., Brooks, T. A., & Brooks, R. M. (1992). Subject control of the literature of Acquired Immunodeficiency Syndrome (AIDS). *Information Processing and Management,* 28(1), 89-98

Bierbaum, E. G., & Brooks, T.A. (1995). The literature of Acquired Immunodeficiency Syndrome (AIDS): Continuing changes in publication patterns and subject access. *Journal of the American Society for Information Science,* 46(7), 530-536

Björneborn, L., & Ingwersen, P. (2004). Towards a basic framework of webometrics. *Journal of the American Society for Information Science and Technology,* 55(14), 1216-1227

Bloch, S., & Walter, G. (2001). The Impact Factor: Time for change. *Australian and New Zealand Journal of Psychiatry,* 35, 563-568

Boelaert, M. (2001). *Data collection and analysis.* Antwerp: Institute of Development of Policy and Management, University of Antwerp.

Bookstein, A. (1990). Informetric distributions, Part 1: Unified overview. *Journal of the American Society for Information Science,* 41 (5), 368-375.

Bookstein, A., Kulyukin, V., Raita, T., & Nicholson, J. (2003). Adapting measures of clumping strength assess term-term similarity. *Journal of the American Society for Library Science and Technology,* 54(7), 611-620

Bookstein, A., & Raita, T. (2001). Discovering term occurrence structure in text. *Journal of the American Society for Information Science,* 52(6), 476-486

Bookstein, A., Kulyukin, V., Raita, T., & Nicholson, J. (2003). Adapting measures of clumping strength assess term-term similarity. *Journal of the American Society for Library Science and Technology,* 54(7), 611-620

Brookes, B. C. (1968). The derivation and application of the Bradford-Zipf distribution. *Journal of Documentation,* 24, 247-265

Brookes, B. C. (1969). Bradford's law and the bibliography of science. *Nature,* 224, 953-956

Brown, P. (1993). Has the AIDS research epidemic spread too far? *New Scientist,* 138(1873), 12-15

Callon, M., Courtial, J.-P., & Laville, F. (1991). Co-word analysis as a tool for describing the network of interactions between basic and technological research: The case of polymer chemistry. *Scientometrics,* 22(1), 153–203.

Callon, M., Law, J., & Rip. A. (1986). *Mapping of the dynamics of science and technology*. London: Macmillan.

Cameron, B. D. (2005). Trends in the usage of ISI bibliometric data: Uses, abuses, and implications. *Libraries and the Academy*, 5(1), 105-125

Center for Research, on Education, Diversity & Excellence (2002). Glossary. Retrieved June 10, 2006, from http://crede.berkeley.edu/tools/glossary.html

Centro de Información y Documentación Científica, (2004). Research groups. *Cybermetrics: Journal of Scientometrics, Informetrics and Bibliometrics*. Retrieved February 19, 2004, from http://www.cindoc.csic.es/cybermetrics/links01.html

Chan, L. C. Y., Jin, B., Rousseau, R., Vaughan, L., & Yu, Y. (2002). Newspaper coverage of SARS: A comparison among Canada, Hong Kong, Mainland China. [Online]. *Cybermetrics*, 6/7 (2002/3), 1-12. Retrieved May 23, 2004 from http://www.cindoc.csic.es/cybermetrics/articles/v6i1p1.pdf

Chen, C. (2004) Searching for intellectual turning points: Progressive knowledge domain visualization. *Proceedings of the National Academy of Sciences of the United States of America (PNAS)*. Retrieved February 19, 2006, from http://www.pnas.org/cgi/reprint/0307513100v1.pdf

Chisenga, J. (2004). *Application possibilities of agricultural information portals*. Unpublished PhD Thesis. Accessed on October 10, 2005, from the University of Zululand Library

Cohen, J. (2000a). Balancing the collaboration equation. *Science*, 288(5474), 2155-2158.

Cohen, J. (2000b). Is AIDS in Africa a distinct disease? *Science*, 288(5474), 2153-2155

Cohen, J. (2000c). Major international AIDS research collaborators. *Science,* 288(5474), 2156

Coile, R. C. (1977). Lotka's frequency distribution of scientific productivity. *Journal of the American Society for Information Science,* 366-370.

Committee on Science, Engineering, and Public Policy [COSEPUP]. (2004). Implementing the Government Performance and Results Act: a status report. Washington, D.C.: National Academy of Sciences.

Commonwealth of Australia. (2004). Review of closer collaboration between universities and major publicly funded research agencies. Retrieved November 8, 2004, from http://www.dest.gov.au/Collaboration/documents/pub.bdf

Commonwealth Scholarship Commission & Economic and Social Research Council. (nd.). *African Universities: Supporting future generations.* London: Commonwealth Scholarship Commission.

Conlon, C. P. & Snydman, D. R. (2004). *Mosby's color atlas and text of infectious diseases.* Edinburgh: Mosby.

Coulter, N., Monarch, I., & Konda, S. (1998). Software engineering as seen through its research literature: a study in co-word analysis. *Journal of the American Society for Information Science,* 49(13), 1206-1223.

Courtial, J.-P. (1994). A co-word analysis of scientometrics. *Scientometrics,* 31(3), 251–260.

Courtial, J.-P., & Law, J. (1989). A co-word study of artificial intelligence. *Social Studies in Science,* 19, 301–311.

Davis, P. M. (2002). Where to spend our E-Journal money? Defining a university library's core collection through citation analysis. *Libraries and the Academy,* 2(1), 155-166

Dayton, J. (1998). *World Bank HIV/AIDS interventions: ex-ante and ex-post evaluation: Background paper for confronting AIDS, public priorities in a global epidemic*. Washington, D.C.: World Bank.

De Cock, K. M., Ekpini, E., Gnaore, E., Kadio, A., Gayle, H. D. (1994). The public health implications of AIDS research in Africa. *Journal of American Medical Association*, 272(6), 481-486.

Ding, Y., Chowdhury, G. G, & Foo, S. (2001). Bibliometric cartography of information retrieval research by using co-word analysis. *Information Processing and Management,* 37, 817-842

Diodato, V. (1994). *Dictionary of Bibliometrics*. New York: Haworth.

Drott, M. C. (1981). Bradford's law: Theory, empiricism and the gaps between. *Library Trends,* 30, 41-52

Dube, L. & Ocholla, D. N. (2004). A review of management and diffusion strategies of HIV/AIDS information in institutions of higher education in South Africa. In T. J. D. Bothma & A. Kaniki. *Prolissa 2004: proceedings of the 3rd biennial DISSAnet conference*, Pretoria, October, 28-29. Pretoria: Infuse, p. 149-171.

Duque, R. B., Ynalvez, M., Sooryamoorthy, R., Mbatia, P., Dzorgbo, D.-B., & Shrum, W. (n.d.). Collaboration paradox: Scientific productivity, the Internet, and problems of research in developing areas. Retrieved November 4, 2004, from http://worldsci.net/global/paradox.pdf

Ecosystem Management Initiative. (2002). Collaboration. Retrieved August 14, 2005, from http://www.snre.umich.edu/ecomgt/collaboration/definitions.htm

Egghe, L. (2005). Editorial: Expansion of the field of informetrics: origins and consequences. *Information Processing and Management,* 41, 1311-1316

Egghe, L., & Rousseau, R. (1990). *Introduction to informetrics: quantitative methods in library, documentation and information science*. Amsterdam: Elsevier.

Eisenhart, M. A. (1991). Conceptual frameworks for research circa 1991: Ideas from a cultural anthropologist; implications for mathematics education researchers. *Proceedings of the 13th annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*, 1, 202 –219

Farmer, P. (1999). *AIDS and social scientists: critical reflections*. In C. Becker et. al., (eds.). Experiencing and understanding AIDS in Africa. Dakar: CODESRIA.

Fernandez, M. T., Sancho, R., Morillo, F., De Filippo, D., & Gomez, I. (2003). Comparative analysis of ISI (SCI & SSCI) and MEDLINE databases in the biomedical sciences: Case study of 24 Latin American and Caribbean countries. In: J. Guohua, R. Rousseau & W. Yishan. *Proceedings of the 9th International Conference on Scientometrics and Informetrics – ISSI*, 55-67

Garfield, E. (1971). Publication counting vs citation counting in evaluating research *Essays of an Information Scientist*, 1, 179-181

Garfield, E. (1972). Citation analysis as a tool in journal evaluation. *Science* 178, 471-479

Garfield, E. (1973). Citation analysis as a tool in journal evaluation: journals can be ranked by frequency and impact of citations for science policy studies. *Essays of an Information Scientist*, 1, 527-544.

Garfield, E. (1979). Scientometrics comes of age. *Current Contents*, 5-10.

Garfield, E. (1989). Evaluating research: Do bibliometric indicators provide the best measure? *Current Contents*, 3-10.

Garfield, E. (1993). *New Scientist* examines AIDS research with ISI 's citation data. *Current Contents*, 27, 3-12

Garfield, E. (1996). Citation indexes for retrieval and research evaluation. Paper presented at Consensus Conference on the Theory and Practice of Research Assessment, Capri., October 7th, 1996. Retrieved February 6, 2003, from http://garfield.library.upenn.edu

Garfield, E. (1998). The multiple meanings of impact factors. *Journal of the American Society for Information Science,* 49(8), 768

Gauthier, E. (1998). Bibliometric analysis of scientific and technological research: A user's guide to the methodology. Retrieved November 4, 2004, from http://www.statcan.ca/english/research/88F0006XIE/88F0006XIB1998008.pdf

Geisler, E. (2001). The Mires of Research Evaluation. *The Scientist,* 15(10), 39-41

Gillaspy, M. L., & Huber, J. T. (1996). The literature of women and the Acquired Immunodeficiency Syndrome (AIDS): implications for collection development and information retrieval. *Medical References Services Quarterly,* 15(4), 21-39

Glazel, W. (2002). Co-authorship patterns and trends in science: A bibliometric study with implications for database indexing and search strategies – 1980-1998. Retrieved November 4, 2004, from http://www.findarticles.com/p/articles/mi_m1387/is_3_50/ai_88582625/pg_1

Gooden, A. M. (2001). Citation Analysis of chemistry doctoral dissertations: An Ohio State University case study. Retrieved March 30, 2005, from http://www.istl.org/01-fall/refereed.html

Grant, S. L. (1994). ADONIS: for developing countries? Retrieved March 30, 2006, from http://www.ifla.org/IV/ifla60/60-gras.htm retrieved 29th March 2005.

Hartinah, S., Davis, M., Hydari, A., & Kent, P. (2001). Indonesian nutrition research papers 1979-98: A bibliometric analysis. In: M Davis & C. S. Wilson (eds.). *Proceedings of the 8th International Conference on Scientometrics and Informetrics,* Sydney, July, 16-20, 1, 225-177.

He, Q. (1999). Knowledge discovery through co-word analysis. *Library Trends,* 48(1), 133-159

He, S. (2001). Geographic distribution of foreign authorship in LIS journals. A comparison between *JASIST* and *Journal of Documentaion*. In: M. Davis & C.S. Wilson (eds.). *Proceedings of the 8th International Conference on Scientometrics and Informetrics,* Sydney, July, 16-20, 2, 235-243.

Hertzel, D. (1987). Bibliometrics, history of the development of ideas in: Statistical bibliography or bibliometrics? In: A Kent & H. Lancour (Eds). *Encyclopaedia of Library and Information Science*, 42, 144-219.

The Holy Bible. King James Version (Electronic edition of the 1979 edition of the 1611 Authorized version). In: Logos Research Systems CD-ROM. (1996). Logos Bible Software v2.0b. Oak Harbor, WA: Logos Research Systems.

Hood, W. W., & Wilson, C. S. (2001). The literature of bibliometrics, scientometrics and informetrics. *Scientometrics,* 52(2), 291-314

Hornby, A. S. (2000). *Oxford Advanced Learner's Dictionary*. Oxford: Oxford University Press

Huber, J. C. (1998). Cumulative advantage and success-breeds-success: The value of time pattern analysis. *Journal of the American Society for Information Science*, 49(5), 471-476

Hubert, J. J. (1981). General bibliometric models. *Library Trends*, 30, 65-82

Hui, S. C., & Fong, A. C. M. (2004). Document retrieval from a citation database using conceptual clustering and co-word analysis. *Online Information Review*, 28(1), 22-32

Ikpaahindi, L. (1985). An overview of bibliometrics: Its measurements, laws and their applications. *LIBRI*, 35 (2), 163-177.

Institute of Higher Education, Shanghai Jiao Tong University. (2005). Top 500 world universities. Retrieved September 30, 2006, from

InterLab. 2005. Webometrics ranking of world universities. Retrieved April 10, 2006, from http://www.webometrics.info/

ISI. (2002). The ISI® journal selection process. Retrieved May 3, 2005, from http://connect.ISIhost.com/jrnlselection.html

ISI. (2004). The ISI database: the journal selection process. Retrieved April 22, 2005, from http://www.ISInet.com

ISI. (2006). Journal Use Reports™. Retrieved July 19, 2006 from http://scientific.thomson.com/webofknowledge/media/JUR_Fact_Sheet.pdf

Jacobs, D. (2000). Institutional status, funding and grading in relation to faculty research productivity. *Progress in Library and Information Science in Southern Africa: proceedings of the first biennial DISSAnet conference*, 143-153. Glenstantia: Infuse

Jacobs, D. (2002). Scientometrics of genetic research and development in South Africa, 1990-2001. In: T. Bothma & A. Kaniki eds. *Progress in Library and Information Science in Southern Africa: proceedings of the second biennial DISSAnet conference*, 93-103. Glenstantia: Infuse

Jacobs, N. (2002). Co-term network analysis as a means of describing the informational landscapes of knowledge communities across sectors. *Journal of Documentation*, 58(5), 548-562

Kaiser Family Foundation. (2005). News release: United Secretary-General Kofi Annan launches Global Media AIDS Initiative. Retrieved August 25, 2005, from http://www.kff.org/newsroom/phip011504nr.cfm

Katz, J.S. & Hicks, D. 1997. How much is a collaboration worth? A calibrated bibliometric model. *Proceedings of the Sixth Conference of the International Society for Scientometrics and Informetrics,* Jerusalem, Israel, June 16-19, p. 163-175.

Katz, J.S. & Martin, B.R. (1997). What is research collaboration? *Research policy,* 26(1), 1-18

Keller, E. F. (2005). Revisiting "scale-free" networks. *BioEssays,* 27, 1060-1068

Kellerman, F. R. (1997). *Introduction to health sciences librarianship: A management handbook.* Westport, CT: Greenwood Press.

Kentucky Virtual Library. (2004a). How to do research: Why evaluate information sources? Retrieved April 19, 2005, from http://www.kyvl.org/html/tutorial/research/whyeval.shtml

Kentucky Virtual Library. (2004b). How to do research: Some useful tours. Retrieved April 19, 2005, from http://server2003.irandoc.ac.ir/InfoLit%20Documents/web%20site/Site_files/51.htm

King, J. (1987). A review of bibliometric and other science indicators and their role in research evaluation. *Journal of Information Science,* 13, 261-276.

Konforti, B. 2001. Twenty years ago. *Nature Structural Biology,* 8(7). 582

Kopcsa, A., & Schiebel, E. (1998). Science and technology mapping: A new iteration model for representing multidimensional relationships. *Journal of the American Society for Information Science,* 49(1), 7-17

Kostoff, R. N. (2000). Evaluating productivity. *The Scientist,* 14(20), 4

Kostoff, R. N. (2001). Science and Technology Metrics. Retrieved April 11, 2002, from Defence Technical Information Center. Information for the Defence Community Website http://www.dtic.mil/dtic/kostoff/Metweb5_IV.htm

Kreiner, K., & Schultz, M. (1993). Informal collaboration in R&D: The formation of networks in organizations. [Online]. *Organization studies.* Retrieved November 4, 2004, from http://www.findarticles.com/p/articles/mi_m4339/is_n2_v14/ai_14443077

Krichel, T. (2002). LIS618 lecture 6: citation indexing. Retrieved April 16, 2005, from http://openlib.org/home/krichel/lis618n02a/lis618n02a-06.ppt

Krsul, I. (2002). Co-word analysis tool. Retrieved on December 3^{d}, 2003, from http://www.acis.ufl.edu/~ivan/coword/algorithmdescription.pdf.

Lamptey, P., Wigley, M., Carr, D. & Collymore, Y. (2002). Facing the HIV/AIDS pandemic. *Population Bulletin,* 57(3). Washington, D.C.: Population Reference Bureau.

Lancaster, F.W. (1991). *Bibliometric methods in assessing productivity and impact of research.* Bangalore: Sarada Ranganathan Endowment for Library Science.

Laudel, G. (2001). What do we measure by co-authorships? In: M Davis & C. S. Wilson (eds.). *Proceedings of the 8th International Conference on Scientometrics and Informetrics,* Sydney, July, 16-20, 2, 469-476.

Law, J., & Whittaker, J. (1992). Mapping acidification research: A test of the co-word method. *Scientometrics,* 23(3), 417–461.

Lawani, S. M. (1987). The Ortega hypothesis, individual differences, and cumulative advantage. *Scientometrics,* 12(5-6), 321-323

Leedy, P. D. (1997). *Practical research: planning and design.* New Jersey: Prentice-Hall

Lewison, G. (2001). From biomedical research to health improvement. *Scientometrics,* 54 (2), 179-192

Lewison, G., & Must, U. (2001). Estonian international cooperation in science in the 1990s: New politics, new methods. In: M. Davis & C. S. Wilson (eds.). *Proceedings of the 8th International Conference on Scientometrics and Informetrics,* Sydney, July, 16-20, 2, 385-395.

Lewison, G., Lipworth, S., & de Francisco, A. (n.d).. A bibliometric approach to estimating malaria research funding. Retrieved January 25, 2005, from http://www.globalforumhealth.org/forum_6/sessions/3Thursday/ResourcesLewisonBibliographic.pdf

Leydesdorff, L. (1988). Words and co-words as indicators of intellectual organization. *Research Policy,* 18:209-223

Leydesdorff, L. (2004). FullText.exe for Full text analysis. Retrieved June 18, 2006, from http://www.leydesdorff.net

Lupton, D., Chapman, S., & Wong, W. L. (1993). Back to complacency: AIDS in the Australian press. *Health Education Research,* 8(1), 5-17

Macias-Chapula. (1990). Production and dissemination of the Mexican biomedical journals, with some considerations of the Latin American/Caribbean region. In L. Egghe & R. Rousseau. *Informetrics 89/90*

Macias-Chapula, C. A. (2000). AIDS in Haiti: a bibliometric analysis. *Medical Library Association. Bulletin,* 88(1), 56-61

Macias-Chapula, C. A. & Mijangos-Nolasco, A. (2002). Bibliometric analysis of AIDS literature in Central Africa. *Scientometrics*, 54 (2), 309-317.

Macias-Chapula, C. A., Rodeo-Castro, I. P., & Narvaez-Berthelemot, N. (1998). Bibliometric analysis of AIDS literature in Latin America and the Caribbean. *Scientometrics,* 41(1-2), 41-49

Macias-Chapula, C. A., Sotolongo-Aguilar, G. R., Magde, B., & Solorio-Lagunas, J. (1999). Subject analysis of AIDS literature, as produced in Latin America and the Caribbean. *Scientometrics,* 46(3):563-574.

Macías Chapula, C. A., Mendoza-Guerrero, J. A., Rodeo-Castro, I. P., Gutierrez-Carrasco, A., & Juarez-Sanchez, E. (2006). Collaboration on HIV/AIDS research in Latin America and the Caribbean: Comparison of regional and international databases. In: *Proceedings The International Workshop on Webometrics, Informetrics and Scientometrics*, Nacy (France). *E-Prints in Library and Information Science.* Retrieved August 10, 2006, from http://eprints.rclis.org/archive/00006039

MacLean, M., Anderson, J., & Davis, C. (1997). Making malaria bite. *Nature Medicine,* 3(1), 14-16

Maglaughlin, K. L. & Sonnenwald, D. H. (2005). Factors that impact interdisciplinary natural science research collaboration in academia. In: P. Ingwersen & B. Larsen. *Proceedings of ISSI 2005 – the 10th International Conference of the International Society for Scientometrics and Informetrics,* Stockholm, Sweden, Jul 24-28, pp 499-508

Me´decins Sans Frontie`res (MSF) (2003). HIV/AIDS. Retrieved July 18, 2005, from http://www.accessmed-msf.org/campaign/hiv01.shtm

Merton, R. K. (1988). The Matthew Effect in science, II: cumulative advantage and the symbolism of intellectual property. *ISI,* 79, 606-623

Moeller, S. (2000). Coverage of AIDS in Africa: The media are silent no longer. *Nieman reports,* 54(3), 89

Momen, H. (2004). The role of journals in enhancing health research in developing countries. *Bulletin of the World Health Organization,* 82(3), 163

Muhondwa, E. P. Y. (1991). The social implications of AIDS. *The Courier, 126: AIDS – the big threat*: In: Medical and Health Library CD-ROM.

Mweene, H.V. (n.d). Basic science research: The case for a regional approach. Retrieved April 1, 2003, from http://www.iitap.iastate.edu/reports/stafrica/HabatwaDARed.html

Narvaez-Berthelemot, N., Russell, J. M., Arvanitis, R., Waast, R., & Gaillard, J. (2001). Science in Africa: An overview of mainstream scientific output. In: M. Davis & C. S. Wilson (eds.). *Proceedings of the 8th International Conference on Scientometrics and Informetrics,* Sydney, July, 16-20, 2, 469-476.

National Institute of Allergy and Infectious Diseases (NIAID). (2003). General information about HIV/AIDS treatment. Retrieved February 4^{h}, 2005, from http://www.niad.nih.gov/daids/therapeutics/geninfo/geninfo.htm#1

National Institutes of Health. (2005). List of Journals indexed for MEDLINE, 2005. Retrieved June 14, 2006, from ftp://nlmpubs.nlm.nih.gov/online/journals/lsiweb.pdf

National Science Foundation. (1996). Science and engineering indicators, 1996. Retrieved February 23rd, 2005 from http://www.nsf.gov/sbe/srs//seind96/ch5_art1.htm

Neuman, W. L. (2000). *Social research methods: qualitative and quantitative approaches* (4th ed.). Boston: Allyn and Bacon.

Nichol, F.D. (1979). The Seventh-day Adventist Bible Commentary: The Holy Bible with exegetical and expository comment. Washington, D.C.: Review and Herald Publishing Association. In: Logos Research Systems CD-ROM. (1996). Logos Bible Software v2.0b. Oak Harbor, WA: Logos Research Systems

Nicholas, D. & Ritchie, M. (1978). *Literature and bibliometrics.* London: Clive Bingley.

Nicholls, P. T. (1989). Bibliometric modeling processes and the empirical validity of Lotka's law. *Journal of the American Society for Information Science*, 40(6), 379-85

Nisonger, T.E. (2004). The benefits and drawbacks of impact factor for journal collection management in libraries. *The Serials Librarian*, 47(1/2), 57-75

Nordberg, E. (ed). (2001). *Communicable diseases: a manual for health workers in Sub-Saharan Africa.* Nairobi: African Medical and Research Foundation.

Ocholla, D. N. (2000). *Research capacity in library and information science in South Africa – an overview.* Paper delivered at the 66th IFLA Council and General Conference, Jerusalem, Israel, 13th-18th August. Retrieved April 4, 2002, from http://www.ifla.org/IV/ifla66/papers/054-127e.htm

Ocholla, D. N. (2003). Using informetrics for analyzing indigenous knowledge. A paper prepared at the International Conference on Collaboration and Sharing of Knowledge, 30-31 July 2003, Senate Hall, Theo van Wyk Building, Main Campus, Muckleneuk Ridge, UNISA, Pretoria.

O'Connor, D. O. & Voos, H. (1981). Empirical laws, theory construction and bibliometrics. *Library Trends*, 30, 9-20

Onyancha, O.B. (2006). Empowering the South African community's AIDS intervention workforce: An informetric study of HIV/AIDS research projects, with special reference to masters and doctoral dissertations and theses. *South African Journal of Libraries and Information Science,* 72(1), 56-71

Onyancha, O.B. & Ocholla, D.N. (2004a). An informetric analysis of the corruption literature based on Africa between 1990 and 2001. *South African Journal of Libraries and Information Science, 70(2), 86-98*

Onyancha, O.B. & Ocholla, D.N. (2004b). A comparative study of the literature on HIV/AIDS in Kenya and Uganda: A bibliometric study. *Library & Information Science Research*, 26(2004), 434-447

Onyancha, O.B. & Ocholla, D.N. (2005). An informetric investigation of the relatedness of opportunistic infection to HIV/AIDS. *Information Processing and Management,* 41, 1573-1588

Onyancha, O.B. & Ocholla, D.N. (2006). HIV/AIDS research and the youths: An informetric analysis of the literature. *South African Journal of Libraries & Information Science,* 72(2):85-97

Organization for Economic Co-operation and Development. (1997). *The evaluation of scientific research: selected experiences.* Paris: Organization for Economic Co-operation and Development.

Osareh, F. and Wilson, C. S. (2001). Iranian scientific publications: Collaboration, growth, and development from 1985-1999. In: M. Davis & C. S. Wilson (eds.). *Proceedings of the 8th International Conference on Scientometrics and Informetrics,* Sydney, July, 16-20, 2, 499-509.

Osca, J. (1997). Spanish bibliographic production on AIDS. Bibliometric approach. *Enfermedades Infecciosas y Microbiologia Clinica,* 15(8), 407-410.

Palmquist, M. (n.d.). Content Analysis. Retrieved June 21, 2006, from http://www.colostate.edu/Depts/WritingCenter/references/research/content/page2.htm

Palmquist, R. A. (2001). Bibliometrics. Retrieved March 31, 2005, from http://www.gslis.utexas.edu/~palmquis/courses/biblio.html

Pao, M. L. (1986). An empirical examination of Lotka's law. *Journal of the American Society for Information Science,* 37(1), 26-33

Pao, M.L. & Goffman, M. 1990. Quality assessment of schistosomiasis literature. In L. Egghe & R. Rousseau. *Informetrics 89/90,* p.

Persson, O., Glazel, W., & Danell, R. (2003). Inflationary bibliometric values: The role of scientific collaboration and the need for relative indicators in evaluative studies. In: J. Guohua, R. Rousseau & W. Yishan. *Proceedings of the 9th International Conference on Scientometrics and Informetrics – ISSI*, 411-420

Phelan, T. J. (2000). Evaluation of scientific productivity. *The Scientist*, 14(19), 39-41

Popescu, I. I. (2002). Science journal ranking by average impact factors. Retrieved August 26, 2005, from http://www.geocities.com/iipopescu/Jo_rankingb.htm

Population Reference Bureau, PRB. (2004). *2004 world population data sheet of the Population Reference Bureau*. Washington, D.C: PRB

Potter, W.G. (1981a). Introduction. *Library Trends*, 30, 5-7

Potter, W. G. (1981b). Lotka's law revisited. *Library Trends*, 30, 21-39

Pratt, G.F. (1992). A decade of AIDS literature. *Bulletin of the Medical Library Association*, 80(4), 380-381.

Presidential AIDS Advisory Panel. (2001). A synthesis report of the deliberations by the panel of experts invited by the President of the Republic of South Africa, the Honorable Mr. Thabo Mbeki. Retrieved June 23, 2006, from http://www.virusmyth.net/aids/data/panel/aidsreport.pdf

Price, D. S. (1976). A general theory of bibliometric and other cumulative advantage processes. *Journal of the American Society for Information Science*, 27(5), 292-306

Rao, I. K. R. (1983). *Quantitative methods for Library and Information Science*. New York: John Wiley.

Rao, I. K. R. (1990). Journal productivity in economics. In L. Egghe & R. Rousseau. *Informetrics 89/90*

Rao, I. K. R., & Neelameghan, A. (1992). From librametry to informetrics: An overview and Ranganathan's contributions. *Libri*, 42 (3), 242-257.

Rao, M. K., & Raghavan, K. S. (2003). Collaboration in knowledge production: A case study of superconductivity research in India. In: J. Guohua, R. Rousseau & W. Yishan. *Proceedings of the 9th International Conference on Scientometrics and Informetrics – ISSI, 230-240*

Ravi, S. (2001). Growth and collaborative trends in nuclear science research literature: a case of India, 1980-1994. In: M. Davis & C. S. Wilson (eds.). *Proceedings of the 8th International Conference on Scientometrics and Informetrics*, Sydney, July, 16-20, 2, 573-585.

Reitz, J. M. (2002). Online Dictionary of Library and Information Science. Retrieved May 2, 2002, from http://vax.wcsu.edu/library/odlis.html

Republic of Kenya, Ministry of Health. (2001). Health management information systems: report for the 1996 to 1999 period. [Nairobi]: The Republic.

Rodrigues, P. S., Fonseca, L., Chaimovich, H. (2000). Mapping cancer, cardiovascular and malaria research in Brazil. *Brazilian Journal of Medical and Biological Research*, 33(8), 853-867

Rosenberg, D. (2002). African Journals OnLine Publishing Project (AJOPP). Retrieved August 7, 2004, from http://www.inasp.org.uk/psi/ajopp

Rousseau, R. (2002). Journal evaluation: technical and practical issues. *Library Trends*, 50(3), 418-439

Saravanavel, P. (1991). *Research methodology*. Allahabad: Kitab Mahal

Schneider, J. W., & Borlund, P. (2004). Introduction to bibliometrics for construction and maintenance of thesauri: Methodical considerations. *Journal of Documentaion*, 60(5), 524-549

The Scientist. (1996). Citation analysis reveals leading institutions, scientists researching AIDS. *The Scientist,* 10(15), 12-13

Seglen P. O. (1997). Why the impact factor of journals should not be used for evaluating research. *British Medical Journal,* 314, 498-502

Self, P. H. C., Filardo T. H. W. and Lancaster, F. W. (1989). Acquired Immunodeficiency Syndrome (AIDS) and the epidemic growth of the literature. *Scientometrics,* 17(1-2), 49-60.

Sen, S. K. (1999). For what purpose are the bibliometric indicators and how should they work? Retrieved April 23, 2002, from www.ricyt.edu.ar/s_sen.doc

Sengupta, I. N. (1992). Bibliometrics, informetrics, scientometrics and librametrics: An overview. *Libri,* 42(2), 75-98

Silverio, A. (2002). HIV research in Africa. *Stanford Journal of International Relations.* Retrieved April 14, 2006, from http://www.stanford.edu/group/sjir/3.2.05_silverio.html

Small, H., & Greenlee, E. (1990). A co-citation study of AIDS research. In C.L. Borgman (Ed.), *Scholarly communication and bibliometrics,* 166–193. Newbury Park, CA: Sage.

Smith, D. & Katz, J. S. (2000). Collaborative approaches to research: HEFCE fundamental review of research policy and funding. Retrieved November 4th, 2004, from www.nerf-uk.org/nerf/word/webcolabhefce.doc?version=1

Smith, L. C. (1981). Citation analysis. *Library Trends,* 30, 83106

Sodha, R. J. (1993). Trends in biomedical publications: US and Japanese authors in US journals and European journals. *Journal of Information Science,* 19, 71-73.

The South African Universities Vice-Chancellors Association, Higher Education HIV/AIDS Programme, (2004). *HIV and AIDS audit: Interventions in South African higher education.* Pretoria: Higher education HIV/AIDS programme.

Spilsbury, M. (2000). CIFOR – using a "systems" approach to research evaluation: paper prepared for the Impact Assessment Workshop Organized by the Standing Panel on Impact Assessment (SPIA) of the Technical Advisory Committee (TAC) of the CGIAR. Rome: FAO.

Standerfer, A. (1998). Bradford's Law. Retrieved March 18th, 2002, from the University of Illinois, Graduate School of Library and Information Science Website: http://alexia.lis.uiuc.edu/~standrfr/bradford.html

Stegmann, J. (1999). Why not use journal impact factors. *EAHIL newsletter,* 47. Retrieved May 3, 2005, from http://www.cindoc.csic.es/cybermetrics/pdf/579.pdf

Steynberg, S., & Rossouw, S. F. 1995. Multiple authorship in biomedical papers: A South African case study. *Journal of the American Society for Information Science*, 46(6), 468-472.

Tague, J., Beheshti, J., & Rees-Potter, L. (1981). The law of exponential growth: Evidence, implementation and forecasts. *Library Trends*, 30, 125-149.

Tsay, M. & Yu, H. (2002). Bibliometric analysis of indexing and abstracting literature, 1977-2000. *Proceedings of the 4th International Conference on Conceptions of Library and Information Science*, Seattle, USA, July 21-25, 327-331

Turnbull, D. (2000). Bibliometrics and the Worldwide Web. Retrieved March 18, 2002, from http://donturn.fis.utoronto.ca/research/bibweb.html

Turner, W., Chartron, G., Laville, F., & Michelet, B. (1988). Packaging information for peer review: New co-word analysis techniques. In A. Van Raan (Ed.), *Handbook of quantitative studies of science and technology*, 291–323. Amsterdam: North Holland

Twining, J. (2001). Bibliometrics – an overview. Retrieved July 12, 2003, from the University of Denver Website: http://www.du.edu/~jtwining/LIS4326/bibliometrics.htm

UNAIDS. (2003a). AIDS epidemic update: December 2003. Retrieved December 18, 2003, from http://www.unaids.org/wad2003/Epiupdate2003_en/Epi03_03_en.htm#P28_3962

UNAIDS. (2003b). *Accelerating action against AIDS in Africa*. Geneva: UNAIDS.

UNAIDS. (2004). *2004 report on the global AIDS epidemic: 4th global report.* Geneva: Joint United Nations Programme on HIV/AIDS.

UNAIDS. (2006). *2006 report on the global AIDS epidemic: A UNAIDS 10th anniversary special edition.* Geneva: UNAIDS.

Ungern-Sternberg, S. (1995). Applications in teaching bibliometrics. *Proceedings of the 61st IFLA General Conference*, 20th – 25th August. Retrieved February 20, 2002, from http://www.ifla.org/IV/ifla61/61-ungs.htm

Ungern-Sternberg, S. (2000). Scientific communication and bibliometrics. Retrieved March 19, 2002, from http://abo.fi/~sungern/comm00.htm

United Nations International Childrens Fund (UNICEF). (2003). Malaria and HIV/AIDS. Retrieved July 25, 2006, from http://www.unicef.org/health/files/UNICEFTechnicalNote6MalariaandHIV.doc

United States of America. One Hundred Third Congress. (1993). Government Performance and Results Act of 1993. In: Committee on Science, Engineering, and Public Policy. (1999). *Evaluating Federal Research Programs: Research and the Government Performance and Results Act.* Washington, D.C.: National Academy of Sciences, 57-78.

University of Maryland, Health Sciences and Human Services Library. (2004). Scolarly communication in transition: What is Open Access? Retrieved November 7, 2006, from http://www.hshsl.umaryland.edu/scholarly/openaccess.html

Vickery, B. C. (1948). Bradford's law of scattering. *Journal of Documentation,* 4, 198-203

Victoria, U. (n.d.). Introduction to Informetrics. Retrieved August 4, 2002, from http://kmi.open.ac.uk/people/victoria/Informetrics.htm

Wagner, C. S., & Leydesdorff, L. (2003). Mapping global science using international co-authorships: A comparison of 1990 and 2000. In: J. Guohua, R. Rousseau & W. Yishan. *Proceedings of the 9th International Conference on Scientometrics and Informetrics – ISSI,* 330-340

Wallace, D. P. (1989). Bibliometrics and citation analysis. In: *Principles and Applications of Information Science for Library Professionals.* Chicago: American Library Association, 10-26.

Wang, Y., Yishan, W., Yuntao, P., & Zheng, M. (2003). Status of collaboration in science and technology in China as reflected in co-authorship. In: J. Guohua, R. Rousseau & W. Yishan. *Proceedings of the 9th International Conference on Scientometrics and Informetrics – ISSI,* 421-429

Whittaker, J. (1989). Creativity and conformity in science: Titles, keywords, and co-word analysis. *Social Science in Science.* 19, 473– 496

WHO. (2001). HIV/AIDS in the Caribbean: Issues and options. Washington, D.C.: World Bank.

WHO. (2004). Malaria and HIV/AIDS interactions and implications: Conclusions of a technical consultation convened by WHO, June 23-25. Retrieved July 25, 2006 from, http://www.who.int/hiv/pub/prev_care/en/WHO%20Malaria%20and%20AIDS.pdf

Wikipedia Encyclopedia. (2006). East Africa. Retrieved July 31, 2006, from http://en.wikipedia.org/wiki/East_Africa

Wolfram, D. (2000). Applications of informetrics to information retrieval research. *Special issues on Information Science Research,* 3(2), 77-82

Wormell, I. (1998). Informetrics: Exploring databases as analytical tools. *Database* (1998):25-30. Retrieved December 15, 2004, from http:/www.onlineinc.com/databse

Wormell, I. (2000). Informetrics – a new era of quantitative studies. *Education for Information,* 18(2000), 131-138

Wormell, I. (2001). Informetrics for informed decision making: Seminar Paper, Swedish-Lithuanian Seminar on Information Management Research Issues, held on 21-22, Sept. 2001, at the University College of Boras, Sweden. Retrieved February 19, 2002, from http://www.hb.se/bhs/seminar/semdoc/wormell.htm

Wyllys, R. (1981). Empirical and theoretical bases of Zipf's Law. *Library Trends*, 30, 53-64

Yitzhaki, M. (2001). Relation of title length of journal article to length of article. In: M. Davis & C. S. Wilson (eds.). *Proceedings of the 8th International Conference on Scientometrics and Informetrics,* Sydney, July, 16-20, 2, 759-769

Yitzhaki, M., & Shahar, T. (2000). The emergence of alternative medicine as a new field: A bibliometric study of a rapidly-growing field. *Proceedings of the 66th IFLA Council and General Conference,* Jerusalem, Israel 13-18 August. Retrieved January 7, 2003, from http://www.ifla.org/IV/ifla66/papers/055-127e.htm

Yoshikane, F., & Kageura K. (2003). Comparative analysis of co-authorship networks of different domains: the growth and change of networks. In: J. Guohua, R. Rousseau & W. Yishan. *Proceedings of the 9th International Conference on Scientometrics and Informetrics – ISSI,* 362-367

APPENDIX A

LIST OF JOURNALS PUBLISHED IN AFRICA AND COVERED IN THE MEDLINE, SCI AND SSCI DATABASES

MEDLINE

Algeria:

- ✓ Archives. Institut Pasteur d'Algerie

Egypt:

- ✓ Eastern Mediterranean Health Journal
- ✓ The Egyptian Journal of Immunology / Egyptian Association of Immunologists
- ✓ The Journal of Egyptian Public Health Association
- ✓ Journal of the Egyptian Society of Parasitology

Ethiopia:

- ✓ Ethiopian Medical Journal

Kenya:

- ✓ African Journal of Health Sciences
- ✓ East African Medical Journal

Madagascar:

- ✓ Archives de l'Institut Pasteur de Madagascar

Nigeria:

- ✓ African Journal of Medicine and Medical Sciences
- ✓ African Journal of Reproductive Health
- ✓ Nigerian Journal of Medicine
- ✓ The Nigerian Postgraduate Medical Journal
- ✓ West African Journal of Medicine

South Africa:

- ✓ Cardiovascular Journal of South Africa
- ✓ Curations
- ✓ Journal of South African Veterinary Association
- ✓ Medicine and Law
- ✓ The Onderstepoort Journal of Veterinary Research
- ✓ SADJ
- ✓ The South African Journal of Communication disorders
- ✓ South African Journal of Surgery
- ✓ South African Medical Journal

Uganda:

- ✓ African Health Sciences

Tunisia:

- ✓ Archives de l'Institut Pasteur de Tunis
- ✓ La Tunisie Medicale

Zimbabwe:

- ✓ The Central African Journal of Medicine

SCIENCE CITATION INDEX

Ethiopia:

- ✓ Ethiopian Medical Journal (ISSN: 0014-1755) / Ethiopian Med Assn, Addis Ababa, Ethiopia
- ✓ Bulletin Of The Chemical Society Of Ethiopia (ISSN: 1011-3924) / Chem Soc Ethiopia, Addis Ababa, Ethiopia

Kenya:

- ✓ Discovery And Innovation (ISSN: 1015-079x) / Academy Science Publishers, Nairobi, Kenya
- ✓ African Journal Of Biotechnology (ISSN: 1684-5315) / Academic Journals, Nairobi, Kenya

South Africa:

- ✓ Onderstepoort Journal Of Veterinary Research (ISSN: 0030-2465) / Onderstepoort Veterinary Inst, Agricultural Research Council, Onderstepoort, South Africa
- ✓ SAMJ South African Medical Journal (ISSN: 0256-9574) / Med Assoc S Africa, Pinelands, Johannesburg, South Africa
- ✓ South African Journal Of Animal Science (ISSN: 0375-1589) / South African Journal Of Animal Sciences, Hatfield, South Africa
- ✓ South African Journal Of Botany (ISSN: 0254-6299) / Natl Inquiry Services Centre Pty Ltd, Grahamstown, South Africa
- ✓ South African Journal Of Chemistry-Suid-Afrikaanse Tydskrif Vir Chemie (ISSN: 0379-4350) / Bureau Scientific Publ, Pretoria, South Africa
- ✓ South African Journal Of Geology (ISSN: 1012-0750) / Geological Soc South Africa, Marshalltown, South Africa
- ✓ South African Journal Of Science (ISSN: 0038-2353) / Acad Science South Africa Ass Af, Lynwood Ridge, South Africa
- ✓ South African Journal Of Surgery (ISSN: 0038-2361) / Med Assoc S Africa, Pinelands, Johannesburg, South Africa
- ✓ South African Journal Of Wildlife Research (ISSN: 0379-4369) / Southern African Wildlife Management Assoc, Bloubergstrand, South Africa
- ✓ Water SA (ISSN: 0378-4738) / Water Research Commission, Pretoria, South Africa

SOCIAL SCIENCES CITATION INDEX

- ✓ Perspectives In Education (ISSN: 0258-2236) / Perspectives In Education, Univ Pretoria, Groenkloof Campus, Faculty Education, Pretoria, South Africa
- ✓ Social Dynamics-A Journal Of The Centre For African Studies University Of Cape Town (ISSN: 0253-3952) / The Centre, Rondesbosch, South Africa
- ✓ South African Journal Of Economics (ISSN: 0038-2280) / Economic Soc South Africa, Pretoria, South Africa
- ✓ South African Journal Of Psychology (ISSN: 0081-2463) / Psychological Soc South Africa, Broadway, South Africa

APPENDIX B

LIST OF TERMS USED TO CONDUCT CO-WORD ANALYSIS OF HIV/AIDS LITERATURE

Opportunistic Infections

Burkitt's Lymphoma
Cancer
Candidiasis
Carcinoma
Coccidioidomycosis
Cryptococcosis
Cryptosporidiosis
Cytomegalovirus
Encephalopathy
Herpes Simplex
Histoplasmosis
Immunoblastic Lymphoma
Isosporiasis
Kansasii
Kaposi's Sarcoma
Leukoencephalopathy
Lymphoma
Mycobacterium Avium Complex
Pneumocystis carinii
Pneumonia
Progressive Multifocal Leukoencephalopathy
Salmonella
Shigella
Staphylococcus aureus
Streptococcus pneumoniae
Toxoplasmosis
Tuberculosis
Varicella zoster
Wasting Syndrome

Pre-Disposing Factors

Alcoholism
Broken Marriage
Conflict
Culture
Disability
Discrimination
Drug Abuse
Gender
Handicapped
Ignorance
Illiteracy
Inequality
Labor Migration
Marginalization
Malnutrition
Orphans
Poverty
Primitivity
Rape
Refugees
Rural
Sanitation

Socioeconomic Factors
Substance Abuse
Underdevelopment
Uneducated
Unemployment
Urbanization
Violence
War

Risk Factors

Adultery
Anal Sex
Bacterial Vaginosis
Blood Transfusion
Breastfeeding
Chlamydia
Circumcision
Condom Attitudes
Drug Abuse
Extramarital sex
Gays
Genital Herpes
Gonorrhea
Heterosexuality
Homosexuality
Injections
Infected Mothers
Milk
Mother-to-infant transmission
Needlestick injury
Non-usage of Condoms
Oral Sex
Promiscuity
Prostitution
Rape
Saliva
Sex
Sexual Intercourse
Sexually Transmitted Diseases
Substance Abuse
Syphilis
Unprotected Sex

Sexually Transmitted Diseases

Bacterial Vaginosis
Candidiasis
Chancroid
Chlamydia
Condylomata Acuminata
Genital Warts
Gonorrhea
Granuloma Inguinale
Hepatitis B
Herpes Zoster
Human Papillomavirus Infection
Lymphogranuloma Venereum
Molluscum Contagiosum
Pediculosis Pubis
Pelvic Inflammatory Diseases
Pubic Lice
Scabies
Sexually Transmitted Diseases
Syphilis
Trichomonal Vaginalis

Trichomoniasis

Other Diseases

Amebiasis

Cholera

Dengue

Ebola

Giardiasis

Guinea-Worm

Hepatitis

Hookworm

Hypertension

Jaundice

Leishmaniasis

Lymphatic Filariasis

Malaria

Malnutrition

Meningitis

Onchocerciasis

Polio

Schistosomiasis

Sickle Cell

Syphilis

Trypanosomiasis

Tuberculosis

Typhoid

Yellow Fever

APPENDIX C: PhD STUDIES IN INFORMATION SCIENCE AT THE UNIVERSITY OF ZULULAND: ONYANCHA, O. BOSIRE (013106)

No	Activity	Time/Duration (Months)												Remarks	2004	2005	2006	2007
		J	F	M	A	M	J	J	A	S	O	N	D					
1	Proposal preparation																	
2	Registration																	
3	Devt., submission and correction of Chap 1: Introduction																	
4	Devt. and delivery of Chap. 2: Literature Review																	
5	Corrections & submission of Chapters 1 & 2																	
6	Devt. and submission of Chap. 3: Research methodology																	
7	Compilation of research instruments																	
8	Approval of research instruments																	
9	Data collection																	
10	Devt. and delivery of Chap. 4: Analysis of Data																	
11	Devt. and delivery of Chap. 5: Analysis of Data																	
12	Correction and submission of Chapters 4, & 5																	
13	Devt., and delivery of Chap. 6: Discussions																	
14	Correction and submission of Chap. 6																	
15	Devt., correction and submission of Chap. 7: Summary, conclusions & recommendations																	
16	Submission and correction of draft dissertation																	
17	Submission of final dissertation																	
18	Examination of Dissertation																	
19	Corrections based on examiners report																	
20	Submission of final bound dissertation to examination section																	
21	Graduation with PhD Degree in Information Science																	

Key recommendations for outcomes/remarks: Agreed, submitted, re-submitted, approved, suspended, completed