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Abstract
This paper presents preliminary results of research in progress regarding the correlation between research and the disease morbidity by subject content analysis of AIDS literature, as produced in India. An SCI & AIDSLINE/OVID literature search was conducted to obtain papers with at least one Indian address from 2004-2009. A total of 2195 unique records were obtained for the study period and analyzed. Subject areas accounting for most papers were - HIV infection, HIV & TB, Risk Factors, Risk Behavior, Prevention and Control, Mother to Child Transmission, Mode of Transmission, and Identifying Population. Results indicate that major research areas covered by scientists more recently are on women studies. A switch from studies of males to females and HIV coupled with other opportunistic infections like Tuberculosis and Hepatitis. The results were compared with the disease morbidity in India and indicate a high correlation between the research papers and the disease prevalence. The research in India is fully supporting the objectives of control measures for the disease in country, with an indication for more research efforts towards different issues associated with ART.

Introduction and Literature Survey
When acquired immune deficiency syndrome (AIDS) was first recognized in early 1981, few would have predicted that it would escalate into a modern day plague, with over 40 million individuals infected worldwide. Indeed, AIDS is an exceptional infectious disease, posing challenges in terms of immediate needs and long-term development. In India, since the first report of HIV infection in 1987¹¹, the rate of viral incidence and prevalence remained low and stable over the years. According to the National AIDS Control Organization (NACO)¹⁶, the overall viral prevalence among the general adult population of India remains at 0.36% as of 2006 which translates to approximately 2.5–3.0 million cases¹⁷. The reasons for significantly lower levels of viral incidence in India as compared to African countries, where subtype C is also the predominating strain, are not completely understood. Socio-economic conditions, cultural factors, host genetics and family traditions may have played or are playing an important role. Approximately 2.5 million people were living with HIV/AIDS in India in 2007, with the overall adult prevalence rate estimated at 0.3 percent.¹⁷,36-40 HIV has been detected in almost all of India’s states and union territories¹⁶-¹⁷. The Government of India (GOI) has pledged to provide free antiretroviral drugs. Global partners are also supporting the country’s efforts to control the epidemic. Large-scale prevention programmes are being funded through the Bill and Melinda Gates Foundation and the Global Fund for AIDS, TB and Malaria (GFATM)¹⁸. India also now has the largest number of HIV-TB co-infected persons in the world. In addition to increasing the number of active TB cases, HIV can be expected to increase TB associated mortality in India.⁶,24,28,34,35,42-44 HIV-associated morbidity and mortality will put an increasing, costly burden on public and private medical care systems.⁴²-⁴³. Although India harbors the second largest number of HIV infections in the world, the number of scientific studies and research publications appearing from India remains rather small and inadequate.²⁹ To understand India’s strengths and capabilities and to know the areas being covered by the scientists, a bibliometric study with a focus on “Content Analysis” of papers is needed to better understand the situation. The rate of growth of AIDS literature has been reported to be of exponential nature.²⁷,²⁹ in India. This growth is similar to rapid increase in number of reported cases of AIDS since it was first published in 1981.¹⁷.
Several bibliometric studies have been published on AIDS over the world (1-3,5,7-8,12-15,19-23,26-27,29). These studies have evolved from descriptive, quantitative analyses of AIDS literature (1,3,5,8-9,12-15,23,26-27,33), to more qualitative subject and citation analyses. The findings obtained from these studies have provided a general picture of the history and growth of AIDS literature from the unsettled nature of the terminology during the early 1980s, to a more structured and controlled Medical Subject Headings (MeSH) terminology. Through citation studies, clusters of topics representing networks and maps of AIDS have been obtained (2,7,13-14,19-23,35,41). However, factors related to variation in HIV research productivity in India in terms of ‘content analysis’ have not been examined.

Objectives & Methodology
Therefore, this study aims to fill some of the gap in existing research to provide insights into disease status, research areas of scientists and their correlation to the requirement of the ‘population’. This ‘Research in progress’ study looks at the growth over time of Indian AIDS research output based on bibliographic data from AIDSLINE (a sub-database of MEDLINE-Bethesda) & Web of Science so as to support the decision making process of researchers, policy makers and health workers. The results will indicate if the actual research is complimenting the needs of the nation. This study will also explore the growth of AIDS research in India over time and identify active researchers. An analysis will be done for Indian institutions, and their productivity and core journals as the study progresses and visual mapping will also be done for ‘subject analysis’ and the ‘collaboration pattern’.

The data for the study have been captured using the following search strategy:

“TS = (HIV Infections OR HIV OR HIV-1* OR HIV-2* OR HIV1 OR HIV2 OR HIV infect* OR human immunodeficiency virus OR human immunodeficiency virus OR human immunodeficiency virus OR human immune-deficiency virus OR acquired immunodeficiency syndrome OR acquired immunodeficiency syndrome OR acquired immunodeficiency syndrome OR acquired immune-deficiency syndrome OR AIDS) AND India (affiliation field) AND 2004-2009 (Year of Publication)”

The key words have been picked up from the ‘Abstract’ & ‘Title’ field of each and every record and were standardized in consultation with peer group of researchers in the field and the MeSH. The data pertaining to the general health profile of Indian population has been collected from the “Yearly Report-National Health Profile-India” being published by the “Directorate General of Health Services-India”17. The health profile and disease morbidity/mortality from AIDS/HIV have been compared with the areas of research papers. This would provide an evidence based information to the policy makers about the areas of concentrated research and the thrust areas in relation to the health profile. To test the data for any association between the prevalence and the ‘papers produced’ the Pearson Correlation coefficient has been applied and its significance has been tested. To reduce the scatter of the data “transformation” (a statistical technique) has been used. Authorship distribution is being examined using Lotka's law. As the present study is based only on the papers indexed in AIDSLINE & SCI, it is not possible to encompass all the work from India.

Observations & Discussion
India is one of the largest and most populated countries in the world, with over one billion inhabitants. Of this number, it's estimated that around 2.27 million people are currently living...
People living with HIV in India come from diverse cultures and backgrounds. The vast majority of infections occurs through heterosexual sex (80%), and is concentrated among high risk groups, such as prostitutes, drug users, truck drivers, infected mothers etc.

Productivity of Papers & Collaboration:

Figure 1: Total papers from India (2004-2009) & their Citation Report

During the years 2004-2009, a total of 2195 papers were produced with at least one Indian address with an av. citation per year of 1145.43 and 5.08 av citation per paper. The yearly analysis of data shows that there is a rapid growth of literature from 2004-2009 (Fig. 1) and citation also. Still, in an international sense, relative productivity of India and it’s impact is low and requires more focused research and development. It was found that most of the Indian studies are performed as a multicentric project. Most collaboration took place with the USA, UK, Germany and France and in partnership between national and foreign institutions.

Funding for research in India comes from national sources like ICMR, NACO, Department of Biotechnology, and the Department of Science and Technology; from international agencies such as WHO, USAID, UNAIDS, the National Institutes of Health in the USA, UK Medical Research Council, UK Department for International Development, Indo-French collaborations, and from international foundations such as the International AIDS Vaccine Initiative, Gates Foundation and the Clinton Foundation.

Content Analysis:

The papers have been analyzed for the subject area by “content analysis” of ‘Abstract Field’ and the ‘Title’ fields of every record. The analysis has been carried out by a special programme developed by us through ‘MS Visual Basic-2.0’. Most publications are coauthored and focus on ‘HIV & TB’ (10.4%), ‘prevention & control’ (7.8%), ‘mother to child transmission’ (6.5%) & ‘women’ (3.5%). Detailed analysis indicated that, these papers cover a wide range of disciplines including serological and molecular characterization of the viral strains in India, elucidation and characterization of the recombinant strains, study of the economic impact of the viral infection, examination of the immune profile of the host, delineating the natural history of HIV-1/ AIDS, evaluation of the awareness among general populations, molecular validation of the primary viral isolates and study of their pathogenic properties including neuro-pathogenesis, developing and evaluating alternative therapeutic strategies for HIV/AIDS, vaccine development and validation in human clinical trials, etc.

The following Figure 2 provides a visual representation of the subset of the data which have been extracted after content analysis of the abstracts of each record and transforming the data for better representation. The graph has been made after applying log transformation to reduce variation in data.
A co-word analysis has also been done using the software developed by Prof. Loet Leydesdorff available at [http://www.leydesdorff.net/software.htm](http://www.leydesdorff.net/software.htm) and Pajek 2.00. The map clearly indicates the central core of HIV papers along with 3 major clusters of (a) prevention & control, drug development, (b) progression of disease, epidemiological studies and affected population studies (c) Diagnosis. Tuberculosis is not a risk factor for HIV infection but, HIV-infected individuals become immunodeficient and as a result often develop the commonest endemic disease in the country, namely tuberculosis (TB). As a consequence TB is the most common HIV-related infection in India. The incidence of TB in HIV-infected individuals is much higher than in the general population. People infected with TB and HIV have a 5-8% annual risk and a 30% or greater lifetime risk of developing active TB. Swaminathan and others reported an incidence rate of 7.1 per 100 person years in skin test positive and 6.9 per 100 person years in skin test negative HIV-positive individuals in south India. Therefore, many studies have looked at...
HIV infections among tuberculosis patients. The analysis of ‘AB’ (Abstract) Field of records revealed that a total of 11% papers discussed about the HIV/Tuberculosis association (Fig. 2). In the absence of an efficacious HIV-1 vaccine in the near future, other antiviral approaches are being actively considered along with the conventional ‘Antiretroviral Therapy (ART)’. There is evidence to suggest that preventive therapy is useful in HIV-positive persons. According to National AIDS Control Organization, 427451 patients have ever started ART in the country till 30th November 2009.\cite{16,17}

State-wise number of ART centres and patients alive and on ART January 2010

<table>
<thead>
<tr>
<th>State</th>
<th>No. of ART Centres</th>
<th>Total(Adult)</th>
<th>Total(Paediatric)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andhra Pradesh</td>
<td>31</td>
<td>60,328</td>
<td>3,304</td>
<td>63,632</td>
</tr>
<tr>
<td>Karnataka</td>
<td>33</td>
<td>36,220</td>
<td>3,003</td>
<td>39,223</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>43</td>
<td>65,409</td>
<td>5,102</td>
<td>70,511</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>36</td>
<td>36,947</td>
<td>2,439</td>
<td>39,386</td>
</tr>
<tr>
<td>Gujarat</td>
<td>9</td>
<td>12,765</td>
<td>669</td>
<td>13,434</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>10</td>
<td>10,039</td>
<td>594</td>
<td>10,633</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td></td>
<td><strong>2,81,453</strong></td>
<td><strong>18,889</strong></td>
<td><strong>3,00,743</strong></td>
</tr>
</tbody>
</table>

But, despite the success of antiretroviral treatment, HIV/AIDS still poses a major public health problem in India. The trend of research reports culminating in form of papers on the topic is also not very encouraging (Fig. 3).

There is a need to do extensive studies on different issues related to ART. Studies focusing clinical trials on ART for treatment and prevention will provide valuable evidence to drive treatment and prevention guidelines. This may be taken up as a thrust area by the policy makers and the funding institutions. The quantum of studies being done, the follow-up studies of patients undergoing ART and the success of the treatment all are very important from the public health point of view.

Some of the papers have reported the study on the indigenous systems of medicine and homoeopathy from different places in India. The analysis of the content of the abstracts has indicated that the products from Ayurveda and Siddha have shown encouraging results but extensive studies are needed to further validate these findings. The ‘Institute of Thoracic Medicine’ in Tambaram, Chennai, have reported research in the Siddha system of medicine in collaboration of Central Councils of Research on Ayurveda and Siddha and Homoeopathy.
Correlation between disease prevalence and the research papers on the topic:
The correlation has been calculated using SPSS Ver. 16. The values for prevalence of the AIDS in India and the papers produced by the Indian authors between 2005-09 is $r = -0.922$ & is significant at 0.05 level indicating high level of ‘Negative Co-relation’ which is desired from the ‘research’ point of view. The data on disease prevalence and the comparison with number of papers from India (Fig. 1) clearly indicates that as the number of research papers are growing year wise, the disease morbidity is reducing over the years. ART for treatment and prevention is very important, the correlation between disease prevalence and the total papers from India on ART have also been calculated. The data indicates $r = -0.721$ with significance at 0.05 level. The data indicates that the use of ART has reduced significantly, the progression of the disease.

Authorship Pattern:
During the period of study a total of 5595 authors produced 2195 papers from India with an average of 2.55 author per paper. The top ten most productive authors in decreasing order of contribution are S. Soloman & N. Kumarasamy from YRG Center, Chennai, S. Gupta from PGIMER, Chandigarh A. Kumar from Armed Forces Med Coll, Pune S. Kumar from Military Hosp, Pune S. Singh from AIIMS, New Delhi K.H. Mayer from Brown University, USA and R. Paranjape from NARI, Pune. To further study the frequency of publication by the authors Lotka’s Law has been applied to the data. To apply Lotka’s law to the data, a software developed by Rousseau and Rousseau (2003) has been used. We found that, if $f(y)$ denotes the relative number of authors with $y$ publications, $f(y) = 0.68/y^{2.23}$. From the software the calculated values for Max D = .0091 and critical values at 1% =0.0218, at 5% =0.0182 and at 10% =0.0163 indicating that the Lotka’s Law applies to the set of data for India at any level. To validate Lotka’s Law, a log-log plot was drawn between the percentage of authors and the percentage of their publications (Fig. 4).

Figure 4: Log-Log Plot between % of Authors & % of their Papers

Authorship productivity data revealed that a total of 5096 (91.10%) authors have contributed 1-5 papers, 331(5.92%) authors have 6-10 papers to their credit, 136 (2.43%) authors have contributed 11-25 papers and only 6 (0.11%) authors have more than 50 papers to their credit. The collaboration pattern in detail, institutional analysis and the journal analysis will be covered as the study progresses further.

Institutional Analysis:
Several laboratories (569) from India have contributed significantly to the knowledge of HIV/AIDS during the years of 2004-2009. The top institutions are All India Inst Med Sci, New Delhi, YRG Centre AIDS Res & Care, Chennai, Post Grad Inst Med Educ Res Chandigarh, Natl AIDS Res Inst ICMR Pune, TB Res Centre ICMR, Chennai, Christian Med Coll & Hosp
The quantum of academic research in India is done mainly by individual investigators affiliated to research institutions, universities and clinics spread across the country, with a few government funded research institutes and non-government organizations making significant contributions

*Journal analysis:*

A total of 707 journals published the total (2195) papers with an Indian address. Out of these 706 journals more than 80% journals are being published from outside India, in the order of UK, USA and Netherlands. Among publishing journals, *Indian J Med Res* is the most productive for HIV/AIDS papers. For the policy makers this is very important, as to decide the available data one has to study the pattern of papers being published from India and the Journals where these papers have been published.
Papers are being published. The following graph indicates that in India, the Papers on AIDS/HIV are scattered in various journals and, there is no core group of journals exclusively for Indian papers. The finding is indicating that in India AIDS/HIV research publishing is in the process of consolidation. The researchers and the information centers have to look for journals from various subject fields. Bradford’s law of scattering has been applied to identify ‘Core’ journals for Indian papers (Fig.7). For Bradford plot, the cumulative total of publications has been plotted against the log of a journal’s rank (decreasing order of contribution). The plot is clearly indicating that top most 40+ journals are coming in the area. Therefore the journals forming a core for Indian papers are Indian J Med Res, AIDS, JAIDS, AIDS Res Hum Retrovirol, Indian J Med Microbiol, Indian J Dermatol Venereol Leprol, Int J STD AIDS, Int J Infect Dis, Lancet, Bioorg Med Chem, Indian J Pathol Microbiol, Natl Med J India, Retrovirology, Indian Pediatrics, Sex Transm Infect, Indian J Pediatr, Tetrahedron Lett, Trop Doct, Clin Infect Dis, J Postgrad Med, Eur J Med Chem, Int J Tuberc Lung Dis, J Trop Pediatr, AIDS Patient Care STDS, Int J Dermatol, J Neurovirol, Bioorg Med Chem Lett, J Med Microbiol, Jpn J Infect Dis, Med Chem Res, Neurol India, QSAR Comb Sci, Acta Cytol, Asian J Chem, BMC Public Health, Indian J Pharm Sci, Trans Roy Soc Trop Med Hyg, ARKIVOC, Curr Sci

Future Leads

The study recommends further research on other parameters along with an in depth research on collaboration vis-à-vis comparison of various population categories, association of HIV/AIDS infection with ‘Hepatitis’, some of the ‘Skin problems’ and other ‘opportunistic infections’. To encourage research excellence need is to take stock of the impact of annual research output and performance by using various quantitative and qualitative S&T indicators, & use them to focus research in areas which help in reducing disease burden of the country. Furthermore, research should be integrated with the clinical unit—a fact that is not easily achievable and not possible with scarce resources. Research funding plays a major role in the creation of relevant research centers in developing countries and in financing research projects and research affiliates the refinement of piloted research methodology, availability of suitable software and funding will be crucial for further research.
References:


NACO: www.nacoonline.org .

National Health Profile India 2004-2009 Available at : http://cbhidghs.nic.in/index1.asp?linkid=267


Rajesh Kumar, Prabhat Jha, Paul Arora, Neeraj Dhingra, Indian studies of HIV/ AIDS working group HIV-1 trends, risk factors and growth in India NCMH Background Papers· Burden of Disease in India WHO

Rousseau B and Rousseau R LOTKA: A program to fit a power law distribution to observed frequency data. Cybermetrics 2000, 4 available at http://cybermetrics.cindoc.csic.es/priebas/v41p4.htm


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