CHAPTER II
REVIEW OF LITERATURE

2.0 INTRODUCTION

In a recent issue of *Scientometrics*, Aleixandre-Benavent, et al.\(^{105}\) (2014) in their article reveal that, “In recent years there has been a growing interest within biomedical sciences in the use of bibliometric indicators that show how scientific publications have contributed to the advancement of knowledge in given areas of inquiry, diseases, or countries. An example of the extensive use of bibliometrics in health sciences is provided by PubMed (2014). In June 2013, it contained 5,369 records under the MeSH (Medical Subject Headings) descriptor “bibliometrics”, having grown from 189 articles in 2001 to 636 in 2011.” Many authors have noticed and reported pinpointedly the growth of bibliometric application to medical subject fields. The investigator has included a review written exclusively by medical subject experts beautifully identifying the strength and weakness of a subject area and this has been presented as a *star paper* with this investigator’s comments.

This chapter presents a review of related literature relevant to the present investigation. The literature review aims to identify,

analyze, assess and interpret a body of knowledge related to a specific topic of scientific enquiry and is normally a requirement as part of a dissertation or thesis. In this case, it sets a context for a research study and provides a rationale for addressing a particular research question to be investigated in the light of an existing body of literature. Review of literature provides in general an overview of the theory and application/practice of a concept, with a special focus on the published literature specific to the topic of investigation. Moreover, it renders support to the proposition of a topic of research, with ample evidences drawn from publications by subject experts and scholars in the concerned field of investigation. The sources consulted for the review of literature here includes certain key documents in Gene Therapy, Scientometric and Bibliometric studies-related materials drawn from Primary periodicals, Secondary databases, Conference proceedings, Technical Reports, Web resources – all these documents published both from India and abroad as well.

The reviews have been sifted and presented here under major categories/grouping with fuzzy boundaries among them as every study includes a number of metric indicators displaying a similarity among them in their methodology excepting the subject treated for analysis, extent of bibliometric application and corresponding results. Under each of the major headings, reviews have been organized in a chronologically descending sequence with publications of recent years
ahead of retrospective years with exceptions belonging to retrospective years chosen to precede the defined order in seldom. The major categorizations are as follows:

2.1 Bibliometrics For Evaluating Scientific Research

2.2 Bibliometrics of Gene Therapy Research: Star Paper

2.3 Bibliometric Studies of Medical Literature

2.4 Citation Classics

2.5 Journal Studies

2.6 Summary

2.1 BIBLIOMETRICS FOR EVALUATING SCIENTIFIC RESEARCH

Koskinen et al.,\textsuperscript{106} (2008) used bibliometric methods in evaluation processes of scientific work. In this paper, some practical clues using Finnish schizophrenia research as an example and comparing the research output of different institutions have been presented. Bibliometric data and indicators including publication counts, impact factors and received citations were used as tools for evaluating research performance in Finnish schizophrenia research. The data were obtained from the Web of Science database with schizophrenia as a keyword and defined address Finland, and limited years to 1996-2005. Finnish schizophrenia research, altogether 265 articles matched the defined criteria. Major findings revealed that, the

number of annually published Finnish schizophrenia articles tripled since the mid-1990s. International co-operation was common (43%). Bibliometric methods revealed differences between institutions, indicating that the methods can be applied in research evaluation. In the views of the authors, Bibliometric methods offer a practical and impartial way to estimate publication profiles of researchers and research groups.

Jonas Lundberg\textsuperscript{107} (2006) This is a PhD thesis report with a presentation of stronger theoretical background to Bibliometrics. It is more educative and informative. The objective of Lundberg as expressed in his PhD work was to explore and develop the utility of bibliometrics as a research assessment tool. The author has achieved her objectives through four studies that address the validity of bibliometrics as a research assessment tool. The issues that are further investigated are related with field delineation (Study I), collaboration (II) and research performance (I/III/IV). The thesis is primarily based on data from the citation indices (CI) produced by Thomson Scientific. To assess the validity of bibliometric indicators calculated using the CI, these are combined with data from PubMed (I) and compared with data from manual assessments (I), financial data (II) and a Swedish system for identification and early assessment of

new methods in health care (IV). Three new indicators are developed based on theoretical reasoning (III).

David Campbell, et al.,\textsuperscript{108} (2004) opined that, as bibliometric indicators are objective, reliable, and cost-effective measures of peer-reviewed research outputs, they are expected to play an increasingly important role in research assessment/management. Recently, a bibliometric approach was developed and integrated within the evaluation framework of research funded by the National Cancer Institute of Canada (NCIC). This approach helped address the following questions that were difficult to answer objectively using alternative methods such as program documentation review and key informant interviews: (a) Has the NCIC peer-review process selected outstanding Canadian scientists in cancer research? (b) Have the NCIC grants contributed to increasing the scientific performance of supported researchers? (c) How do the NCIC-supported researchers compare to their neighbors supported by the U.S. National Cancer Institute? Using the NCIC evaluation as a case study, this article demonstrates the usefulness of bibliometrics to address key evaluation questions and discusses its integration, along complementary indicators (e.g., peer ratings), in a practice-driven research evaluation continuum.

\textsuperscript{108} David Campbell, et al., (2004), Bibliometrics as a Performance Measurement Tool for Research Evaluation: The Case of Research Funded by the National Cancer Institute of Canada.
Bordons and Zuluets\textsuperscript{109} (1999) this review explains the theoretical basis for the application of bibliometrics to scientific research. According to the authors the scope of bibliometric studies is the treatment and quantitative analysis of scientific publications. They belong to the so-called "social studies of science", and science policy constitutes one of its main applied fields. These studies efficiently complement the opinions and judgments of experts, thus providing objective and useful tools for evaluating the results of scientific activity. Nevertheless, given the impact that these evaluations have on the assignment of funding for research and even on the professional career of investigators, it becomes essential to know in detail the characteristics of bibliometric indicators and the limitations of their use. The Science Citation Index database is one of the most employed. In the case of biomedical research it is useful to analyze the most internationally visible scientific production, since it satisfactorily covers biomedical journals; however, clinical research with local interest published in Spanish journals is not included in that database. Widely employed bibliometric indicators are those measuring scientific activity through the number of publications, those based on the citations received by published studies and, in between them, the impact of journals. The impact factor is an indicator very much used in bibliometric studies; though occasionally a high impact factor is

assumed to reflect high quality, this indicator specifically measures visibility and diffusion of the works published by these journals rather than their scientific quality.

2.2 BIBLIOMETRICS OF GENE THERAPY RESEARCH: STAR PAPER

Bibliometrics, though belongs to the core subject Library and Information Science, it is interdisciplinary in nature. Many a time, the authors happen to be library professionals. Sporadically, subject experts combine with library professionals, undertake bibliometric analysis of the subject of their specialization. Here is one (Isserlin et al., 2011) of the very few models wherein subject experts have contributed a thread bare bibliometric analysis and mapping of the subject ‘Human Genome’, with findings regarding the strength and weakness of different areas of genome research. This is a real life mapping of a subject. Hence, the investigator admires this paper as a Star paper and therefore included the authors’ findings mostly unedited. Here is the paper given below.


not taken”. This is an investigation from the subject experts side without involving a library professional. This star studded paper is one of the praise-worthy, rare approaches by scholars belonging to different fields in Medicine. The paper displays a thorough knowledge of the authors in the flawless application of bibliometric indicators efficiently tracking down the strength and weakness of the field ‘genomics and drug discovery’ besides tracing the trend set in genetics, genome and gene therapy. The coverage of data starts form 1950, spans upto 2009, being a pretty long period sufficient enough to scale the finest granule of growth and development of the subject field. The authors report that, the draft sequence of the human genome became available almost a decade ago but the encoded proteome is not being explored to its fullest. This bibliometric analysis of several large protein families, including those known to be "druggable", reveals that, even today, most papers focus on proteins that were known prior to 2000. It is evident that one or more aspects of the biomedical research system severely limits the exploration of the proteins in the 'dark matter' of the proteome, despite unbiased genetic approaches that have pointed to their functional relevance. It is perhaps not surprising that relatively few genome-derived targets have led to approved drugs. The authors have scaled the time and distance fixing an answer as to ‘How quickly are publication patterns changing?’
In their own words, “The H-K effect was initially seen by examining the cumulative number of citations over time (Grueneberg et al.; Federov et al.) for the set of protein kinases. It is possible that the observed H-K effect simply reflects a “carry-over” from pre-genome citations, and that present-day citation patterns are actually changing substantially to focus on the newly discovered family members. To test this idea, the authors performed a similar citation analysis of the protein kinase family but expanded it to include the distribution of citations over time. The authors identified a seminal paper charting the human kinome was published in 2002. There were a total of 80,000 citations prior to 2002 and 120,000 citations after. This analysis revealed that 84% of the citations to protein kinases in 1950-2002 were focused on only 10% of the kinome (50 kinases). Interestingly, the very same kinases continued to garner most of the citations even long after the genome information became widely available (77% of citations between 2003 and 2008, and 74% of the citations in 2009). At the other end of the spectrum, the set of 300 kinases (60% of the kinome) that were at the bottom of the citation list in 2002 remain poorly studied today; in aggregate, they accrued only 5% of the kinase citations in 2009. These data suggest that the availability of the genome sequence has not substantially influenced biomedical research priorities. There are, however, indications that unbiased genome-wide studies are slowly influencing publication trends. The analysis reveals a solution –
the reticence to explore the wider aspects of the genome diminishes greatly as research tools become available. They conclude that the generation of research tools in an unbiased way should be a major objective of the research enterprise, and there should be a reward system in place for those scientists who contribute to this effort. They also conclude that to have maximal impact, the tools must be made available from commercial sources and with no restriction on use.

The above study is an admirable one with a spectrum of results related to the subfields’ strength and weakness identified through bibliometric analysis.

### 2.3 BIBLIOMETRIC STUDIES OF MEDICAL LITERATURE

Ledley, et al.,\(^\text{111}\) (2014) by means of bibliometric analysis, examine the commercialization of gene therapy in the context of innovation theories that posit a relationship between the maturation of a technology and successful product development. The authors show that the field of gene therapy has matured steadily since the 1980s, with the congruent accumulation of >35000 papers, >16000 US patents, >1800 clinical trials and >$4.3 billion in capital investment in gene therapy companies. Gene therapy technologies comprise a series of dissimilar approaches for gene delivery, each of which has introduced a distinct product architecture. Using bibliometric methods,

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the authors quantify the maturation of each technology through a characteristic life cycle S-curve, from a Nascent stage, through a Growing stage of exponential advance, toward an Established stage and projected limit. The authors predict as per the results of the bibliometric analysis, an asynchrony between the maturation of gene therapy technologies and capital investment in development-focused business models may have stalled the commercialization of gene therapy.

Armfield, et al.,\textsuperscript{112} (2014) The authors aimed to provide an up-to-date contemporary bibliometric view of the telemedicine and telehealth literature and a longitudinal analysis of changes in content themes. In an account by the authors, the investigation software tools were used to extract and process MEDLINE entries. This is a longitudinal study with two time windows viz., (i) 1970-1995 and (ii) 2009-2013. Content analysis of abstracts was conducted and tag clouds were generated. This visual representation was used to identify key words and prominent themes. 17,932 records relating to articles published in 2523 unique outlets were analyzed. In the cumulative literature, 3152 (18\%) articles were published in specialist telemedicine journals while most articles (14,780 [82\%]) were published in mainstream outlets. This pattern was observed in both epochs. Clinical

journals were not highly represented. Over time 46,066 unique authors have contributed to the field, with 21,109 of them publishing in the period 2009-2013. Content analysis suggested a change of focus from the technical to the clinical between the two epochs.

Yidan Sun, Hui-Zhen Fu, and Yuh-Shan Ho\textsuperscript{113} (2013) carried out a study to evaluate the global scientific production of genome sequencing research in order to assess the characteristics of the research performances and the research tendencies. Data were obtained from Science Citation Index Expanded database during 1991-2010. Conventional methods including document types, journals, categories, countries and institutions were used to analyze publication output to reveal the global performance. The development of genome sequencing research during last 20 years was described by synthetically analyzing the distribution of words in article title, author keywords and Keywords Plus in different periods. The results show that disease and protein related researches were the leading research focuses, and comparative genomics and evolution related research had strong potential in the near future.

Payam Peymani, Zahra Zahiri, Heydari, Mohammad Khoshsima, and Kamran B. Lankarani\textsuperscript{114} (2012) undertook a bibliometric study which was carried out to investigate the trends in stem cell research in Iran from 1995 to 2010. Original research and review articles were considered and publications were identified with the keyword "stem cell" and an affiliation to an Iranian institution. Data were obtained from the Institute for Scientific Information (ISI) Web of Science databases and Scopus that included 491 articles published since 1995. The mean number of citations per publication was 3.928 and the most frequently cited paper received 76 citations. Articles were published in journals with impact factor that ranged from 0.46 to 8.1. The authors observed an increasing trend in stem cell publications based on research done in Iran, although the rate of citations of these papers was low.

Yang\textsuperscript{115} (2012), aimed to identify global research trends in stem cell transplantation for treating Duchenne muscular dystrophy using a bibliometric data drawn from Web of Science for a period spanned between 2002 and 2011. The major findings revealed the annual publication output; distribution according to subject areas; according to journals; according to country; according to institution; according to


institutions in China; according to institution that cooperated with
Chinese institutions; top-cited articles from 2002 to 2006; top-cited
articles from 2007 to 2011. A total of 318 publications on were retrieved
from Web of Science of which almost half derived from American
authors and institutes. The number of publications gradually increased
over the 10 years. Most papers appeared in journals with a focus on
gene and molecular research, such as Molecular Therapy,
Neuromuscular Disorders. The 10 most-cited papers from 2002 to
2006 were mostly about different kinds of stem cell transplantation for
muscle regeneration, while the 10 most-cited papers from 2007 to 2011
were mostly about new techniques of stem cell transplantation for
treating Duchenne muscular dystrophy.

Thirumagal, A., 116 (2011) A total of 54,373 publications in Stem
Cell research were covered obtaining from MEDLINE database for the
period 1999-2008. USA ranks as the top most country with maximum
number of contributions followed by United Kingdom England and
Netherland as second and third positions respectively. It was found that
about 88.52% of total output was published in English language,
followed by Chinese 2.86% and Japanese 0.94%. "Journal articles"
contributed 75.27% followed by "Comparative Study" 7.45% of the total
output. There was a decrease in Relative Growth Rate and an increase
in the Doubling Time for research productivity from year after year

116 Thirumagal, A., (2011), Stem Cell Research: A Bibliometric Analysis from
throughout the study period. The degree of collaboration has been arrived at 0.9 during the study period. It was found that a maximum number of contributions (1908) were published in the journal 'Blood' followed by Stem Cell with 971 contributions. The research productivity of Stem Cell confirms the implications of Bradford's Law of Scattering. There exists a significant level of difference between Stem Cell research performance of Indian scientists and scientists of other countries. Among the developing countries, India contributes substantially in Stem Cell Research.

Ling-Li Li, et al.,\textsuperscript{117} (2009), in their study aim to evaluate the global scientific production of stem cell research for a period of 16 years and provide insights into the characteristics of the stem cell research activities and identify patterns, tendencies, or regularities that may exist in the papers. Data are based on the online version of SCI, Web of Science from 1991 to 2006. Articles referring to stem cell were assessed by many aspects including exponential fitting the trend of publication outputs during 1991–2006, distribution of source title, author keyword and keyword plus analysis. Based on the exponential fitting the yearly publicans of the last decade, it can also be calculated that, in 2011, the number of scientific papers on the topic of stem-cell will be twice over the number of publications in 2006. Synthetically analyzing three kinds of keywords, the paper concluded that

application of stem cell transplantation technology to human disease therapy, especially research related on “embryonic stem cell” and “mesenchymal stem cell” is the orientation of all the stem cell research in the 21st century. The authors opined that bibliometric method can help relevant researchers realize the panorama of global stem cell research, and establish the further research direction.

Dongui Wen, Te-Chen Yu, and Yuh-Shan Ho118 (2009). The author affiliation in the address field reveals that there exists bibliometric research centre at I-Shou University in Taiwan. Such a centre is really a rare phenomena in India. The objective of this study is to conduct an analysis of citations per publication of all horizontal gene transfer-related publications in the Science Citation Index (SCI). A systematic search was performed using the SCI for publications during the period 1991-2005. The data were based on the online version of the Science Citation Index (SCI), Web of Science. Analyzed parameters included authorship, patterns of international collaboration, journal, language, document type, number of times cited, author, and KeyWords Plus. The USA and Germany produced 57 per cent of the total articles and 77 per cent of the total times cited in three years after publication. In addition, a simulation model was applied to describe the

relationship between the cumulative number of citations and the article life.

**J.A. Wolff, and Lederberg, J** (1994) presented the history of Gene Therapy in their paper. Genetic engineering was first used at the Sixth International Congress of Genetics held in 1932 and was taken to mean "the application of genetic principles to animal and plant breeding." Once the basics of molecular genetics and gene transfer in bacteria were established in the 1960s, gene transfer into animals and humans using either viral vectors and/or genetically modified cultured cells became inevitable. Despite the early exposition of the concept of gene therapy, progress awaited the advent of recombinant DNA technology. The lack of trustworthy techniques did not stop many researchers from attempting to transfer genes into cells in culture, animals, and humans. Viral genomes were used for the development of the first relatively efficient methods for gene transfer into mammalian cells in culture. In the late 1970s, early transfection techniques were combined with selection systems for cultured cells and recombinant DNA technology. With the development of retroviral vectors in the early 1980s, the possibility of efficient gene transfer into mammalian cells for the purpose of gene therapy became widely accepted.

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2.4 BIBLIOMETRIC STUDIES: VARIED MEDICAL FIELDS

Reviews of publications pertained to Bibliometric studies of medical literature are included here under. These publications give a coverage to bibliometric studies covering varied medical fields other than Gene Therapy research.

Dhillon, and Gill,\textsuperscript{120} (2014) undertook a bibliometric study with the purpose to identify publication output as well as descriptively and quantitatively characterize the contribution of Indian pediatric dentists to scientific literature through publication trend analysis from 2002 to 2012. A bibliometric analysis of publications by Indian pediatric dentists during 2002 to 2012 was performed on data collected from PubMed-MEDLINE database. Only the first author’s affiliations were considered and the publications were categorized according to the following variables: year of publication, number of authors, state of origin, type of article, reach of journal and country of publication. There were 817 articles by Indian pediatric dentists during the study period. Of all the articles 399 (48.8%) were original research, 377(46.1%) were case reports and 41 (5.0%) were reviews. The inter-annual variation between the reach, country of publication of the journal and type of articles is presented. The growth trend analysis was performed and predictions are presented.

J.Y. Lee, et al.,\textsuperscript{121} (2014) undertook a bibliometric evaluation of neuro-interventional research published between 2003 and 2012 using the PubMed data base. Between 2003 and 2012, a total of 2123 articles were published, of which 1107 (52.1\%) were original articles, 1948 (91.8\%) were written in English, 192 (9.0\%) received funding, 661 (31.1\%) were published by the United States, and 1060 (49.9\%) resulted from interdisciplinary collaboration. Neurosurgery departments produced the most articles (n = 910, 42.9\%), followed by radiology (n = 747, 35.2\%) and neurology (n = 270, 12.7\%). The time-trend analysis in the number of publications demonstrated slow growth from 2003 to 2012, with an average annual growth rate of +6.0\%.

Kjell Asplund; Marie Eriksson; and Olle Persson.,\textsuperscript{122} (2012) bibliometrically analysed records on Clinical and epidemiological articles on stroke published from 2001 to mid-2011 drawn from Science Citation Index Expanded. Article fractions, citation fractions, h-index, and international collaboration were calculated using the BibExcel software and adjusted for population size and gross domestic product. The United States dominated with 28.7\% of the sum of article fractions and 36.2\% of the sum of citation fractions. The United States, Japan, the United Kingdom, and Germany together accounted for 52.1\%


articles and 61.0% of citations. When adjusted for population size or gross domestic product, several small European countries, together with Israel and Taiwan, ranked the highest. Per population, there was a negative association between burden of stroke (disability-adjusted life-years lost) and number of articles per population. In China, South Korea, and Singapore, the annual growth of stroke articles was more than twice the worldwide average. Whereas multinational collaboration was common within Europe and North America, it was relatively uncommon between Asian countries. The Big 4 in scientific literature on stroke, as to both number of articles and citations, are the United States, Japan, the United Kingdom, and Germany. The authors emphasize the need for enhanced multinational collaboration in Stroke research.

Cantos-Mateos, et al.,\textsuperscript{123} (2012) The output is found mainly concentrating in Cataluna and Madrid, and the authors found that hospitals are the most productive centres (followed by health institutes). Main categories are hematology, oncology and biophysics. The outstanding areas of study revolve around the therapeutic use of transplant of hematopoietic progenitors, the processes of generation, proliferation and differentiation of lines of cells, and the study of neurosciences.

\textsuperscript{123} Cantos-Mateos, G., Vargas-Quesada, B., Chinchilla-Rodriquez, Z., and Zuleta,M.A., (2012), Stem cell research: Bibliometric analysis of main research areas through KeyWords Plus", \textit{Aslib Proceedings}, 64 ( 6), pp.561 – 590.
Jie Hu et al\textsuperscript{124} (2010) undertook a bibliometric analysis based on Science Citation Index (SCI) that was carried out to identify the global research related to lead in drinking water field from 1991 to 2007 and to improve the understanding of research trends in the same period. The major findings revealed that there have been an increasing number of annual publications mainly during two periods: from 1992 to 1997 and from 2004 to 2007. United States produced 37\% of all pertinent articles followed by India with 8.0\% and Canada with 4.8\%. Science of the Total Environment published the most articles followed by Journal American Water Works Association and Toxicology. Summary of the most frequently used keywords are also provided. “Cadmium” was the most popular keyword during the 17 years covered in the study. This seems to be source paper to anyone that may need a historical account of the drinking water research.

Mohammadhassanzadeh and Samadikuchaksarai\textsuperscript{125} (2010) undertook a bibliometric study that obtained a total of 11901 records for the period spanned between the years 1978 and 2007. Of the Iranian publications in the field of Medical sciences, 11761 (98.8\%) records were in English, 101 (0.8\%) in French, 37 (0.3\%) German, 1 (0.008\%)


\textsuperscript{125} Mohammadhassanzadeh, Hafez., and Samadikuchaksarai, Ali., (2010), A Bibliometric Overview of 30 Years of Medical Sciences Productivity in Iran. Archives of Iranian Medicine, 13(4). Pp. 313-317.
in Italian, and 1 (0.008%) in Turkish. Evaluation of international collaborations showed that Iranian scientists established collaboration with scientists of 107 countries. Of those, the most frequent collaboration was with the American scientists (22%). British (16.4%), Canadian (5.9%), Australian (3.7%), French (5.1%) and German (3.1%) scientists were in a descending order of arrangement.

**Li, T., Ho, Y.S., and Li, C.Y.,** **(2008)**. The 200th anniversary of the James Parkinson’s original description of the disease is to be marked that now bears his name. This study explored an alternative statistical approach to quantitatively and qualitatively assessing current research trends on global Parkinson’s disease, using the related literatures from the Institute for Scientific Information (ISI) Web of Science databases during the period of 1991-2006. Articles concentrated on the analysis by scientific output characters, world collaboration, and the frequency of author keywords used. An exponential regression was applied to model the high correlation between cumulative number of articles and the year. International collaborative articles were more prevalent in recent years than earlier years, and increasing international collaboration would lead to more powerful articles due to the sharing of ideas and workloads, while China, Italy, Spain, and Austria are benefit a lot from the international collaboration.

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cooperation. Finally, author keywords were analyzed contrastively, with research trends and recent hotspots provided.

2.5 CITATION CLASSICS (MOST CITED WORKS)

Citation classic was a concept introduced by Eugene Garfield the founder of Institute for Scientific Information (ISI), Philadelphia, United States of America. According to Eugene Garfield\textsuperscript{127,128}, “A Citation Classic is a highly cited publication as identified by the Science Citation Index (SCI) the Social Sciences Citation Index (SSCI), or the Arts & Humanities Citation Index (A&HCI). Citation rates differ for each discipline. The number of citations indicating a classic in botany, a small field, might be lower than the number required to make a classic in a large field like biochemistry. In general, a publication cited more than 400 times should be considered a classic; but in some fields with fewer researchers, 100 citations might qualify a work. Citation Classics authors were asked to write an abstract and a commentary about the publication, emphasizing the human side of the research - how the project was initiated, whether any obstacles were encountered, and why the work was highly cited.”

\textsuperscript{127} Garfield, Eugene., Introducing Citation Classics: The Human Side of Scientific Reports
http://www.garfield.library.upenn.edu/essays/v3p001y1977-78.pdf
Accessed on 05-07-2013.

\textsuperscript{128} Selecting the All-Time Citation Classics. Here are the fifty most-cited papers for 1961-1972.
http://www.garfield.library.upenn.edu/essays/v2p006y1974-76.pdf
Accessed on 05-07-2013.
PubMed enlists papers with their citation frequency which are more while ranking papers on the frequency of citations articles receive under the heading, 100 most cited articles under each of the Biomedical fields. Some samples relevant to the present study are chosen and presented here under.

Hsu and Ho\textsuperscript{129} (2014) aimed to identify and analyze characteristics of highly cited articles published in the Web of Science category of health care sciences and services from 1958 to 2012. Articles that have been cited at least 100 times were assessed regarding publication outputs, distribution of outputs in journals, publications of authors, institutions, countries as well as citation life cycles of the articles with the highest total citations since its publication up to 2012 and the highest citations in 2012. Six bibliometric indicators were used to evaluate source countries, institutions, and authors. Total citations from the time the articles were first published to the end of 2012 and citations in 2012 only were applied. Additionally, Y-index was applied to evaluate publication characteristics of authors. A high percentage of authors had the same numbers of first author and corresponding author status of highly cited articles in health care sciences and services field. Results: Results showed that 890 of the most highly referenced articles, published between 1977 and 2009,

\textsuperscript{129} Hsu, Y.H. and Ho, Y.S. (2014), Highly cited articles in Health care Sciences and services field in Scinece Citation Index Edpanded: A bibliometric analysis for 1958-2012. \textit{Methods inf Med.} 53 (6), pp. 446-458.
had been cited at least 100 times. Medical Care and Journal of General Internal Medicine published the most highly cited articles. The United States produced 76% of highly cited articles and also published the most number of independent, internationally collaborative, first authored, corresponding authored, and single author highly cited articles. The Harvard University was the most productive institute and was number one for the total highly cited articles, inter-institutionally collaborative articles, single institution articles, first author articles, and corresponding author articles. Conclusions: The application of quantitative techniques in the analysis of highly cited articles can improve the researchers' understanding of the directions in health care sciences and services field. Y-index is useful for the evaluation of contributing authors.

Feijoo, J.F., et al., (2014) performed a search in the Web of Science for the most cited articles in all the journals included in the Journal Citation Report (2010 edition) in the category of "Dentistry, Oral Surgery, and Medicine". Each one of the 77 journals selected was analyzed using the Cited Reference Search tool of the ISI Web of Science database to identify the most cited articles up to June 2012. The following information was gathered from each article: names and number of authors, journal, year of publication, type of study, methodological design, and area of research.
The number of citations of the 100 selected articles varied from 326 to 2050. All articles were published in 21 of the 77 journals in the category. The journals with the largest number of the cited articles were the Journal of Clinical Periodontology (20 articles), the Journal of Periodontology (18 articles), and the Journal of Dental Research (16 articles). There was a predominance of clinical research (66 %) over basic research (34 %). The most frequently named author was Socransky SS, with 9 of the top 100 articles, followed by Lindhe J with 7. The decades with most articles published of the 100 selected were 1980-1989 (26 articles) and 1990-1999 (25 articles). The most common type of article was the case series (22 %), followed by the narrative review/expert opinion (19 %). The most common area of study was periodontology (43 % of articles).

X. Yang, et al.,\textsuperscript{130} (2014) used bibliometric analysis methodology in the expanded Science Citation Index to identify highly-cited electrocardiogram (ECG)-related articles with total citations (TC2012) exceeding 100 from the publication year to 2012. Web of Science search tools were used to identify the highly-cited articles. The aspects analyzed for highly cited publications included effect of time on citation analysis, journals and Web of Science categories, number of authors per publication, originating institutions and countries, total

citation and total citation per year life cycles of articles (C2012) and research hotspots. Results showed that a total of 467 electrocardiogram-related publications were regarded as the highly-cited publications. No highly-cited publications have emerged yet during the first two years of the present 2010 decade. All 11 countries and institutions originating highly-cited ECG-related publications were developed countries, USA being one in 9 of them. Four subject categories were identified as hotspots by total citations TC2012 and C2012: atrial fibrillation, long QT syndrome, angina and myocardial infarction, and risk factor analysis and health evaluation.

Paladugu, et al.,\textsuperscript{131} (2014) using the database (1945-1995) of the Science Citation Index, the authors identified 1500 articles cited 100 times and more and the top 100 articles selected for further analysis. The 100 articles were published between 1931 and 1990, with more than two-thirds of them published after 1960. The mean number of citations per article was 405, (range 278-1013). Altogether, 84 of the articles originated from North America (USA 78, Canada 6) and the UK (12). New York State led the list of U.S. states with 14, and Harvard and Columbia University led the list of institutions with 6 articles each. The 100 articles were published in 10 surgical journals. This list of the top-cited papers identifies seminal contributions and their originators, facilitating the understanding and discourse of modern surgical journals.

surgical history and offering surgeons hints about what makes a contribution a "top-cited classic." To produce such a "classic" the surgeon and his or her group must come up with a clinical or nonclinical innovation, observation, or discovery that has a long-standing effect on the way of practice-be it operative or nonoperative. Based on our findings, to be well cited such a contribution should be published in the English language in a high-impact journal.

Eshraghi, et al.,\textsuperscript{132} (2013) This article aimed to identify the 100 top-cited articles in the field of limb prosthetics and to investigate their main characteristics registered in the Web of Knowledge database from the period of 1980 to 2012. The 100 most cited articles in limb prosthetics were selected based on the citation index report. The study design and level of evidence were determined using Sackett's initial rules of evidence. The top cited articles in prosthetics were published from 1980 to 2012 with a citation range of 11 to 90 times since publication. The mean citation rate was 24.43 (SD 16.7) times. Eighty-four per cent of the articles were original publications and were most commonly prospective (76%) and case series studies (67%) that used human subjects (96%) providing level 4 evidence. Among the various fields, rehabilitation (47%), orthopedics (29%), and sport sciences (28%) were the most common fields of study. The study established that studies conducted in North America and were written in English.

had the highest citations. Top cited articles primarily dealt with lower limb prosthetics, specifically, on transtibial and transradial prosthetic limbs. Majority of the articles were experimental studies.

Mariam and Cavanna\textsuperscript{133} (2012) found that the impact of scientific articles is proportional to the citations they have received. In this study, the most cited works ("citation classics") related to Tourette syndrome (TS) were identified as articles with more than 100 citations according to the Web of Science. The study retrieved 89 highly cited articles, which were published in 26 journals: 54 clinical studies, 27 laboratory studies, 7 reviews, and 1 classification article. Clinical studies consisted of phenomenologic evaluations of TS and comorbid behavioral problems (n = 22) and studies on pharmacotherapy (n = 16) and clinical genetics (n = 13), whereas laboratory studies covered basic genetics, cellular and molecular biology (n = 11), and neurobiology (neuroimaging, neuropathology, and neurophysiology) (n = 16). The majority (58\%) of citation classics were published after 1990, when laboratory studies (especially neuroimaging, immunologic, and genetic studies) became widely cited. These articles are able to reach the highest numbers of citations in a short time span and suggest potential directions for future research.

Baltussen and Kindler\textsuperscript{134} (2004) The 74 top-cited articles in critical care journals were identified by a computer search using the database of the Science Citation Index Expanded (SCI-EXPANDED, 1945 to present) and the Web of SCIENCE. The 45 top-cited critical care articles in all other biomedical journals were identified using the database SciSearch (1974 to present) with the key word "Critical Care". The most cited articles received 3402 and 2860 citations, respectively. The citation classics in critical care journals were published between 1968 and 1999 in six high-impact journals, led by Critical Care Medicine (37 articles), followed by the Journal of Trauma (21), and American Journal of Respiratory and Critical Care Medicine (9). Seventy articles were original publications, two were reviews or guidelines, and two were editorials. The top 45 classic articles in non-critical care journals were published in 13 different journals, led by the New England Journal of Medicine (11 articles), followed by JAMA and Lancet (6 articles each). The United States of America contributed most of the classic articles. Pathophysiology of the lung, sepsis and scoring systems were the primary focus of classic publications.

2.6 JOURNAL STUDIES

High impact factor journals might represent an efficient way for its dissemination.

X. Blanc, et al., (2014) The authors selected from PubMed, 15 general and internal medicine journals with the highest impact factor publishing original articles, letters and editorials. Publications from 1996 to 2011 through the full-text search function on each journal website and abstracted bibliometric data were retrieved. A polynomial Poisson regression model with logarithmic link function was used to assess the evolution across the period of the number of publications according to publication characteristics. The investigation identified 1285 publications out of 229,179 publications in 15 journals from 1996 to 2011. The absolute number of publications by journal ranged from 2 to 273 over 16 years. Publications increased both in absolute and relative numbers per year, from 46 (0.32% relative to all publications from the 15 journals) in 1996 to 165 (1.17%) in 2011. This growth was exponential (P < 0.01). The authors found fewer research publications (465, 36.2% of all SDM publications) than non-research publications, which included non-systematic reviews, letters, and editorials. The increase of research publications across time was linear. Full-text search retrieved ten times more SDM publications than a similar PubMed search (1285 vs. 119 respectively). This review in full-text showed that publications increased exponentially in major medical journals from 1996 to 2011.

W.D. Figg, et al.,(2006) The authors undertook a bibliometric study by counting the number of original research articles published in six leading journals -- Cell, Science, Nature, New England Journal of Medicine, The Lancet, and Journal of the American Medical Association -- for the years 1975, 1985, and 1995. Science, Cell, Nature, New England Journal of Medicine, The Lancet, and Journal of the American Medical Association had 2014, 868, 3856, 643, 785, and 465 total articles published during identified 3-years study period, respectively. There was a median of 2, 2, 2, 3, 3, and 3 institutions/article, respectively. All of the final models had a significant linear author component for which all of the parameter estimates were positive, yet variable. Thus, the number of times an article was cited correlated significantly with the number of authors and the number of institutions.

2.7 SUMMARY

There are a number of characteristics peculiar to the Biomedical literature. Till date, United States of America remains the world leader in the context of research literature productivity of journals and Gene Therapy falls in line. PubMed, an open source contains a number of citation classic studies. Such articles on citation classics cover articles in ten folds and one hundred citation classics in various medical fields are found to be common. Bibliometrics studies in Biomedical sciences

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mostly covers normally 10 years window and mostly involve doctors, dentists and pharmacist which is uncommon in many other disciplines. Indian literature, comparatively speaking does not present an impressive figure.