An Analysis of Global Research Trends in Cardiology Over the Last two Decades

ABSTRACT

Introduction: Heart disease today is a major cause of morbidity and mortality plaguing mankind worldwide.

Aim: The present research was undertaken to ascertain global research trends in clinical trials in Cardiology involving human subjects over the last two decades.

Materials and Methods: Cross-sectional study. A detailed search strategy was employed in December 2013, using the PubMed database. All papers published in 1993–2013 were evaluated. The research trends of various cardiologic subspecialties in the United States and worldwide have been analysed and detailed statistical analysis was done.

Results: United States had maximum number of researches.

INTRODUCTION

Today, heart disease is the most prevalent disease plaguing the world, leading to loss of work hours and enormous expenditure. According to the WHO, cardiovascular diseases killed nearly 17 million people in 2011; that is 3 in every 10 deaths [1]. Ischemic heart disease was the leading cause of death in the world in 2011 accounting for 7 million deaths [1]. In The United States alone; about 600,000 people die of heart disease every year [2].

Cardiology has evolved significantly as an academic field. In today’s era; we speak of advancements such as alcohol septal ablation, aortic valve replacement, heart transplantation, and implantable pacemakers and defibrillators. Prognosis and 10y survival rate of patients have shown a concomitant dramatic rise. Multiple investigative modalities such as Electrocardiography (ECG), Echocardiography, Nuclear stress testing and Cardiac catheterization [3,4] have played significant roles in the diagnosis, management and follow up of patients.

The number of medical journals and publications has been increasing over the last decade and Cardiology research has played a significant role in developing new therapeutic and diagnostic procedures which have improved the longevity and quality of life of patients.

Today evidence-based medicine is on the rise, largely helped by clinical trials [5]. Clinical trials highlight the prominent role of Cardiology and the associated research trends in the conditions which affect morbidity and mortality among the general population. In our research, we analysed global trends and research output for clinical trials in the field of Cardiology over the last two decades, including prospective studies, evaluation studies and treatment outcome studies were analysed.

We also analysed data for the number of clinical trials conducted in various cardiologic subspecialties; for example, Advanced Heart Failure/Transplant Cardiology, Interventional Cardiology, Cardiovascular disease and Clinical Cardiac Electrophysiology. To obtain data in each of these four fields, the command was modified as follows:

A) Advanced Heart Failure / Transplant Cardiology


Keywords: Clinical trials, Cardiology subspecialties, Research output
Terms) OR "transplants"[All Fields] OR "transplant"[All Fields] OR "transplantation"[MeSH Terms] OR "transplantation"[All Fields]) AND ("cardiology"[MeSH Terms] OR "cardiology"[All Fields]) AND ("1993/01/01"[PDAT]: "2013/12/07"[PDAT]).

B) Cardiovascular Disease
(("adult"[MeSH Terms] OR "adult"[All Fields]) OR ("aged"[MeSH Terms] OR "aged"[All Fields] OR "elderly"[All Fields]) AND ("cardiology"[MeSH Terms] OR "cardiology"[All Fields]) OR ("heart"[MeSH Terms] OR "heart"[All Fields]) AND (Clinical Trial[ptyp] AND "humans"[MeSH Terms]) AND ("cardiovascular diseases"[MeSH Terms] OR ("cardiovascular"[All Fields] AND "diseases"[All Fields]) OR "cardiovascular diseases"[All Fields] OR ("cardiovascular"[All Fields] AND "disease"[All Fields]) OR "cardiovascular disease"[All Fields]).

C) Clinical Cardiac Electrophysiology
(("adult"[MeSH Terms] OR "adult"[All Fields]) OR ("aged"[MeSH Terms] OR "aged"[All Fields] OR "elderly"[All Fields]) AND ("cardiology"[MeSH Terms] OR "cardiology"[All Fields]) OR ("cardiovascular"[All Fields] AND "diseases"[All Fields]) OR ("cardiovascular diseases"[All Fields] OR "cardiovascular disease"[All Fields])).

D) Interventional cardiology
(("adult"[MeSHTerms] OR "adult"[All Fields]) OR ("aged"[MeSH Terms] OR "aged"[All Fields] OR "elderly"[All Fields]) AND ("cardiology"[MeSH Terms] OR "cardiology"[All Fields]) OR ("cardiovascular"[All Fields] AND "diseases"[All Fields]) OR ("cardiovascular diseases"[All Fields] OR "cardiovascular disease"[All Fields]))

The American Board of Internal Medicine (which was last updated on February 5, 2013) [7] lists the total number of American diplomats...
in each field of Internal Medicine. We used the data to obtain the total number of publications per diplomat within the United States. A website called Gopubmed was also employed in our search strategy [8] which utilizes the data from Pubmed. Search results were consistent on both websites and were verified by several manual checks of the publication trends in each subgroup studied.

Top Year
Publication output of each year was analysed and an attempt was made to arrange the entire output in ascending order.

Top Authors
All authors of different publications were noted. A list of the most prolific top authors was made. Each author’s name was considered by his/her last name; with up to two initials. One must also consider the fact that sometimes two different authors may have the same name; and efforts were made to correct this error as far as is possible [9].

Top Countries and Cities
A list of top countries was prepared; this was done by looking for the country of affiliation of each research article. Sometimes a particular research work was done as an international collaboration. To avoid ambiguity, the country of origin of the first author was considered in all cases. This was the country where the first author’s university/ hospital/ program belonged. The list of top cities was prepared in a similar fashion.

Top Journals
Each journal was studied according to its impact factor and a table was made mentioning the number of publications in each journal publishing Cardiology academic endeavors. The impact factors of all journals were also obtained from the latest Journal Citation Report 2012 [10].

RESULTS
Our search yielded 62857 total human subject clinical trials in Cardiology over the last two decades. Abstracts were available for 61552 of these articles and free full texts were available for 17786 articles. The greatest number of publications was reported in 2012 followed by 2007, 2011, 2008 and 2010 [Table/Fig-1]. Most Cardiology research fields have shown a steady increase in output over the last two decades. The maximum research output was 7722 in the year 2013 and the minimum was 1911 in the year 1993. The mean research output of these 20 y was 4444.

We found that The United States played a dominant role in Cardiology clinical trial research output. The United States topped the list with 23,144 publications followed by Japan at 7283 [Table/Fig-2]. United States, followed by Japan, Italy, Germany, and United Kingdom, comprised the top five countries respectively. Interestingly, Turkey and China are in the top 10, ahead of Canada and France. Boston, London, New York, Athens and Ankara are the top five cities with 1816, 1803, 1602, 1539 and 1423 publications respectively [Table/Fig-3].

Due to limitation of the search engine and lot of authors ;analysis of top 20,000 researches was conducted to look for the top author; Christodoulous stefanaidis had the greatest number of publications among all authors, followed by Kemal Aytemir and Jeroen J Bax. [Table/Fig-4] demonstrates the list of top authors for Cardiology clinical trials in the last two decades. Among Cardiology journals; American Journal of Cardiology and Circulation are the journals with the most publications observed [Table/Fig-5]. We also looked at the latest impact factor for these journals. The Circulation had the highest impact factor among the top 10 journals.

The number of clinical trials in Cardiology was further divided into four subtypes and finer details were analysed. The field of “Cardiovascular Disease” globally was on top with 99248 publications, followed by “Advanced Heart Failure or Transplant Cardiology” ranking second with 7682 clinical trials. This was followed by “Interventional Cardiology” at 4409 and “Clinical Cardiac Electrophysiology” at 772. These results were semantically analysed and were not mutually exclusive.

Data on the number of clinical trials in each disease was also gathered. The studies were further subdivided into followup studies (13,341), Prospective studies (16094), Risk factor analysis (18,327) and Research Reports (15.111), the respective quartiles have been shown in [Table/Fig-6]. [Table/Fig-7] represents the clinical trials done in myocardial infarction, coronary angiography, Atrial Fibrillation, Left ventricular dysfunction ,acute coronary syndrome ,coronary restenosis and coronary angioplasty which were found to be 15461, 11152, 6815, 5844, 4044 and 1709 respectively. Again, these results were semantically analysed and were not mutually exclusive.

The number of board certified diplomats was found from the American Board of Internal Medicine [7] and publication per diplomat was analysed [Table/Fig-8]. This data helped us calculate the number of publications per diplomat in The United States. The publication trends for the different types of clinical trials and clinical conditions have been represented in [Table/Fig-7]. It can be noted that there has been a steady rise in the number of studies involving clinical trials involving myocardial infarction, atrial fibrillation however little variability has been seen in the clinical trials conducted in coronary angiography, left ventricular dysfunction, acute coronary syndrome and coronary restenosis, A declining trend was observed in the field coronary angioplasty [Table/Fig-7].

DISCUSSION
Heart disease has the highest mortality worldwide among all other illnesses [1]. Coronary heart disease alone costs the United States $108.9 billion each year [11]. Approximately every 34 sec, one American has a coronary event and approximately every one minute, an American will die of one [12]. When looking at the situation for patients diagnosed with heart failure, it is again grim with 1 in 9
death certificates (274,601 deaths) in 2009 in the United States mentioning heart failure according to the AHA [10]. This study is an attempt to measure worldwide human subject Cardiology research output with a focus on clinical trials. The study clearly outlines the dominance of The United States in Cardiology research.

The quality of research cannot be ascertained from this study. Nevertheless, it demonstrates the volume of research output in clinical Cardiology and its various subdivisions, including Advanced Heart Failure/Transplant Cardiology, Cardiovascular Disease, Clinical Cardiac Electrophysiology and Interventional Cardiology. Publication trends, in terms of top countries, top cities, top authors and top journals have been analysed.

Looking exclusively at the United States, utilizing the ABIM data; it was surprising that even with the low number of diplomats in the field of Transplant Cardiology; their clinical trials outnumbered the others. The number of publications per diplomat for the United States was analysed. This data reveals the miniscule number of researches being carried out per diplomat, a somewhat surprising fact for a country like The United States which has the highest number of clinical trials. However, the number of publications per diplomat was not analysed for other countries, representing a limitation of this study.

Another limitation of our study is that it analysed only publications in the Pubmed database. Publications in other databases, or research activities which did not produce a potential publication were excluded.

CONCLUSION
It is heartening that research output in Cardiology has increased and improved significantly over the past decade. Yet there is still much to be discovered and many miles to be covered to improve the diagnosis, survival and prognosis of cardiac patients. More clinical trials involving coronary restenosis have to be done to know in depth and add to current knowledge and database.

Therefore, it is necessary that research endeavors continue to be encouraged and the activities of all those involved - students, residents, fellows and cardiologists - merit continued incentives in the form of funds and grants to sustain the worthy academic activity which has cemented the foundation for society’s ever-improving health.

REFERENCES

PARTICULARS OF CONTRIBUTORS:
1. Pediatrics, Medical officer, Government of India, Department of Pediatrics, Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi, India.
2. Medical Student, Department of Pediatrics, Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi, India.
3. Assistant Clinical Professor Member, Center for Carcinoid and Neuroendocrine Tumors Icahn Medical School at The Mount Sinai Medical Center New York, NY

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Rohit Kapoor,
86-A Pocket F GTB Enclave Opp. GTB Hospital Delhi-110 093, India.
E-mail: rohitvmmc@gmail.com

FINANCIAL OR OTHER COMPETING INTERESTS: None.