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Development, Maintenance and Regulation of Multidisciplinary Research Teams to Improve Clinical Research Quality in India - Implications for HR Practice

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Abstract

The overall quality of the clinical research is low in India and there are number of social determinants of health, cultural, institutional, fiscal, financial plus technological factors that affects the performance and management of clinical researchers. The study focuses to understand the important effects of the multidisciplinary clinical research teams and human resource management on the outcomes of the clinical research. The study uses systematic review and thematic analysis as the methodology in order to understand the research problem in detail and provide solutions to the clinical research problems in the country. A total of scholarly 21 articles has been systematically reviewed and four major themes has been found out. The study finds out multiple complex factors that ranges from technical, professional, personal, social, cultural dimensions to institutional and organizational types that needs to be addressed, in order to improve the quality of clinical and medical research in the country. The translational and the implementation sciences has been found to play a critical role in clinical research and the academic-industry collaborations is necessary too. The human resource management plays a cardinal role in the whole undertaken of the clinical research process that has been explained in the research study. The implications of the human resource management and the clinical research management has been mentioned as well, that is to be considered very closely.

Introduction

Research management is highly critical to the development of proper outcomes that are imperative in the scientific settings. The rates of severe diseases and the complications are increasing in India and due to the lack of effective health care and management resources, the public health scenario is affected to a great degree. The cases of hypertension or high blood pressure, diabetes mellitus type 2, heart attacks or cardiovascular accidents, cerebrovascular accidents along with the cases of renal diseases and high blood cholesterols - are increasing (Shrivastava et al., 2017). The prevalence of these diseases is increasing in the public health scenario of the country and there has not been much betterment in the prevalence rates over the last few decades (Misra et al., 2017). Although, the preventive healthcare strategies and wellbeing practices are finding an important place in both community and institutional healthcare frameworks of the country but as compared to the western countries, it is lagging far behind. Lack of health literacy and the problems such as poor socioeconomic status is affecting the accessibility and affordability of the community people to the quality healthcare services, delivered by the multispecialty hospitals in the urban settings (Simon et al., 2018). There are a number of other social determinants of health issues that is impacting upon the public health condition of the country (Tiwari & Jaiswal, 2020). Moreover, there are a number of complex issues and problems with the education system of India such as its rigidity and lack of flexibility for the students to take up different disciplines of choice while moving through the academic continuum (Jain et al., 2018). Poor education management and administration poses a number of threats to the future of the social health and physical health of the diverse communities, residing in the country. Despite having a number of colleges and prestigious institutions along with the government initiatives providing opportunities for the students coming from different and diverse sociocultural backgrounds to basic education – still the overall situation is problem. As for the higher studies at post-graduation level, the problems tend to rise further (Afridi, 2017).

The same problem is almost inherent to the biomedical education, professional health education and higher research in the country that impacts upon the clinical research quality and society. This poor research quality in the clinical settings is a serious problem in the country of India and this is vital to consider as the research problem to be analyzed, scrutinized, and explored in this paper. Poor research quality especially in the clinical domain leads to the development of increased rate of mortality and morbidity as well as the other problems in the healthcare settings of the country that is vital to note as well (Armenta et al., 2018). The lack of compliance with the evidence-based practice standards by the nurses, physiotherapist, physicians, occupational therapist, clinical psychologists, surgeons and the other healthcare professionals contribute to increased rate of readmissions of the patients in the hospitals. While this is a major problem, not having the right evidence or a standardized way of performing a treatment procedure can lead to bigger problems in the clinical scenario, increasing the prevalence rates of adverse and sentinel events (Sai, 2019). But it is also vital to understand, that all kind of clinical care problems begin with the research and development gaps as well as lack of evidence-based and standard operating procedures to be followed (Kumar et al., 2017). Thus, the urgent situation also increases the need for the undertaking of more intense and rigorous clinical and health research in the country. Of the other vital problems in the health care settings, lack of the infection control, lack of understanding about medication, its safety and side effects – are the cardinal ones. The problems with qualitative use of medications and evidence based non-pharmacological management strategies leads to major complications in the hospitals and even community settings (Charani et al., 2019). Multidisciplinary care is critical to provide a comprehensive and holistic care to the patient of different age and community groups. But lack of the much-needed evidence-based multidisciplinary collaboration is one of the chief problems that happens in the Indian health care system. The lack of diverse workforce hiring, lack of resource planning and poor academic frameworks all contribute to the serious problems of low health service quality in India (Jain et al., 2017). As for a matter of fact, the day-to-day health care practices that are undertaken in Indian hospitals and clinics is not research informed to a proper extent that leads to the development of

serious barriers to quality healthcare services delivery to the patients (Garg, Goyal & Singh, 2017). The heavy burden of patients in the health care system of India and less numbers of health care workers such as clinicians who are the line workers and also the supportive staffs make the situation very imbalanced and hazardous at the same time (Indiran, 2017). The lack of enough health care workers and assistive staffs in the health care institutions of the country increases the stress on both the patients and on the clinicians. This indicates to the fact that clinicians being over-burdened with their clinical care role do not get much chances and time to receive their higher education that will allow them and make them competent to undertake clinical research work appropriately (Kadam, 2017). But in the given framework of India where the clinical research needs in the field of nursing, medicine, surgery, physiotherapy, occupational therapy and their subspecialties have become very high – the poorly trained clinicians still take up the critical clinical research work that yields poor results (Downey et al., 2017). This is one of the core clinical research problems that is prevalent and persistent in India for a very long period. The lack of academic-industry relationships, the lack of the proper government policies and institutional protocols as in standardized operating procedures have been found to affect the clinical research quality of the country in a very extensive manner (Figer, Gogtay & Thatte, 2021).

Background

The social determinants of health are very distorted and problematic when it comes to a country like India where the economic and social disparity between the social classes is very high. There are several culturally diverse populations living in the country of India and overall poor socioeconomic status cause the major distortions to take place (Nambiar, 2020). The lack of healthcare awareness as in health care literacy is one of the major problems affecting the low to middle class families of India, who are predominant in numbers. This leads to be development of more complex diseases and multi-morbidities presentation in the different populations, sub-populations and community scenarios of India (Grover, 2019). The lack of health literacy together with the central problem of low earning and low healthcare accessibility cause the major

health problems in the community settings. Mental stress has also been found to be an important factor that contributes to physical illnesses of chronic and acute nature as well. It is to be understood that socioeconomic status of the country is bad and this together with poor health care management and rapidly rising health care costs - is making the overall public health burden of India, much worse (Singh, Srivastava & Upadhyay, 2019). Lack of equipment and inventory management, lack of evidence-based operations and quality management in the hospitals and nursing homes have been all reported to raise the healthcare costs and these costs are then forced to be paid by the patients and their families (Ojha et al., 2020). Waste management, financial planning and leadership capital, workforce management and capital budgeting are the major areas where there are serious deficiencies and this altogether, reduces the affordability, safety and the accessibility of health care in India (Indhulekha, Ganapathy & Jain, 2018). This also affects and increases the numbers of adverse, sentinel events resulting from medication errors, surgical failures and hospital acquired infections, fall incidents in the hospitals and nursing homes. And thus, escalated care becomes a high requirement under emergency circumstances, raising the health care costs further. This in turn again reduces the health accessibility and affordability that are social determinant of health-related problems (Bhargava, Bhargava & Juneja, 2020). More so, the intoxication and addiction issues, social and cultural differences, racial tension and prejudice lead to feelings of discrimination and violence that cause hospital admissions too, at a high rate. These are also critical social determinants of health affecting the public health burden, more adversely. Lack of hygienic living environment and sanitary problems are major problems faced by the vast economically poor population of India and this leads to affection with serious infectious diseases (Hamal et al., 2020). All the social determinants of health are responsible for major health issues and wellbeing deterioration in India, and this creates the needs for a very robust clinical research framework constantly improving the quality of medicine, surgery, epidemiology, allied health and other professions in India. Effective clinical research is essential for reduction of the health care costs, development of best evidence based clinical and patient management practices plus effective research teaching. Thus, effective clinical

research management will help in increasing the potency of the clinical workforce and also the safety of the patients in the hospital care and community care. And this is one critical area that is to be studied in this management research.

The lack of multidisciplinary collaboration in the clinical environment creates the greatest number of risks with the patients and the same barrier has also been seen and found in the clinical research scenario of the country. This affects the not only the outcomes of the clinical research but also the very areas of research teachings that root from different types of clinical research. The overall health care management and administration is poor on India and there is lack of evidence-based management theories and standard operating procedures that are essential to be applied in the hospitals and research centers. This causes major delays and a number of miscommunications between the patients, staffs, researchers, managers and their administrators that had been found to impact the quality of clinical trials undertaken in the country (Chaturvedi, Gogtay & Thatte, 2017). The sociocultural and a socioeconomic situation of the country is problematic that leads to poor funding support from the government and this in turn causes improper resource planning and allocation in the health care and research settings. This then impacts greatly on the clinical research and health care quality, thus affecting the health and wellbeing of the patients with different conditions, in different ways but all in a negative manner. With the number of public health problems and pandemic issues increasing in the country, a substantially functional clinical research system and equally good funding support, a good health care management structure and robust research management has become a necessity (Porandla, 2020). And already, many of the countries across the world have been using many novel approaches and frameworks in clinical research management and related financial and human resource management that is yielding great results (Das, 2017). With the number of medical and surgical cases as well as the lifestyle disease cases increasing in India due to lack of health awareness and lack of digital leadership in health informatics – the need for clinical research in areas of patient management, disease management and technology management is certainly becoming very high (Joshi et al., 2021). As for a matter of fact,

proper funding support, strong public private partnerships and the approval committee support is required to plan, manage, recruit and develop the clinical research workforce in effective manner so that the concerned research is done seamlessly (Jeffery, 2021).

Many researchers have even pointed out that the rigid and unnecessarily outdated education system in the country is amongst the serious problems and factors that prevents competent and able clinical and various biosciences researchers from entering the clinical research field (Gupta & Dubey, 2019). The technology leadership is missing greatly that delays the research education, continuous professional development, data sharing and communication as well as the processes and stages of the clinical research (Patil, & Patil, 2014). Old hierarchical structure of the management in the hospitals and other health care institutions are a source of major issues that affects clinical research, employee engagement and patient health in an adverse way (Kapilashrami & McPake, 2013). And this is highly attributed to the fact that the functional organizational structure and hierarchical structure is not well-formed and well explained in India. According to the United States hospital hierarchical structure, the hospital administrators and health managers are at the top of the organizational administration who actually knows the health care management science and techniques. They oversee the specialist surgeons who in turns oversees the normal specialists. The normal specialists oversee the actions of the silent doctors who are above the nurses. The lowest level of hospital administration is formed by the physical assistants overseeing the medical interns. It is to be noted that though this United States hierarchy structure is followed throughout the globe but there are many functional structures which has been developed nowadays where nursing and medical department have their own individual hierarchy. But in all cases, the hospital administrators are at the top of the organizational administration who oversees the medical, nursing, allied health, housekeeping and supportive services departments (Van Bogaert, Geurden & Weeks, 2012). In India, however, just as the technology leadership, the healthcare organizational structures and hierarchical systems are very ill-defined that leads to more conflicts and issues in regard to multidisciplinary collaboration and research. The place and position of the allied health workers, as it can be

understood are further ill-defined leading to empowerment and workplace discrimination issues that affects the multidisciplinary collaboration and clinical research very much (Germov, 2019). The clinical research training modules and techniques are deficient and outdated in most of the research centers and this leads to various risks with the clinical research projects (Ognibene et al., 2016). Thus, it can be understood that there are a number of factors, barriers and facilitators to the clinical research and its management which are vital to be analyzed and understood further, which has been done in the following sections. The deep analysis of these multiple facilitators and barriers to clinical research, forms the main strata of this management research.

There are a number of biosciences disciplines that can contribute greatly to the outcomes and the undertaking of the clinical research in a much effective manner. Although there are a number of biomedical sciences professionals and researchers in the country, but they hardly get recruited in clinical trials or other clinical research programs which finally leads to increase of the overall research costs and decrease of research safety due to many reasons (Homer-Vanniasinkam & Tsui, 2012). As clinical researches take a number of years and even decades to complete, the amount of stress in the researchers are bound to increase and as the standard operating procedures get very highly difficult to comply with, in clinical research settings which is why the problems are bound to rise (Kumar, 2019). Thus, human resource management according to many reports, have many cardinal challenges to address. According to reports and scientific evidence, human resource managers and executives have a very great role to play in multidisciplinary clinical research team formation and maintenance (Berman et al., 2019). They need to collaborate very effectively with the clinical research managers and study coordinators plus the research center administrators and marketing experts to ensure effective clinical research center infrastructure, operations, quality and financial management (Kshirsagar, Bachhav & Kulkarni, 2013). The human resource managers are majorly responsible for the personnel and performance management and their roles has to be properly utilized and broadened in India. Based on the above factors, the research objectives have been formed.

The research objectives are –

1. To understand the factors, facilitators and barriers to the clinical research
2. To understand the impact of the multidisciplinary team formation on clinical research
3. To understand and analyze the role of human resource management in hiring and managing of multidisciplinary clinical research teams

The research problems are –

1. What are the factors, facilitators and barriers to the clinical research in India?
2. Does the multidisciplinary team formation have a positive effect on clinical research?
3. Does human resource management have a positive effect on the clinical research management?

The research hypotheses are –

H0- Multidisciplinary team formation and human resource management do not have any effect on the outcomes of the clinical research

H1 - Multidisciplinary team formation and human resource management have positive effect on the outcomes of the clinical research

Literature review

There are different types of factors and elements with respect to health care management, human resource management and facility management that is affecting the overall climate of the clinical research in India. A range of barriers and facilitators is actually affecting the clinical research condition in the country. While many of the evidences focus upon the importance of clinical research infrastructure development, others focus on the importance of human resource management. There are many evidences that focus on the factor of workplace discrimination affecting the performance of clinical researchers and many focus on areas like workforce management, resource planning, funding, technology leadership and personnel management.

Hence, it is important to understand that the existing body of knowledge surrounding the multidisciplinary clinical research has been explored in this section.

According to Cuevas et al., (2012), there are a number of benefits and advantages of the multidisciplinary research teams which are development of wide range of research experimental objectives and better coordination for different types of data collection and data analysis activities. It has also been found out by the researchers of the study that regular meetings are very important for the regulation of the multidisciplinary research teams so as to prevent any kind of confusion or conflict. It has also been found out that the mistake proofing as well as time management can be better done with the aid of the multidisciplinary research teams. Although there can be some conflicts while collecting the data - cognitive and technological measures are critical to resolve these issues. According to the researchers, the automation of the processes is vitally critical for reduction of conflicts and human errors, in the multidisciplinary research. Research administration is another very important area that has been highlighted by the study and the software as well as hardware requirements for better management information system control -is vital too. Effective people and project management is also very critical for the prevention of any kind of delays in the research project. According to the researchers of the study, it is important to understand that multiple shared perspectives and diverse knowledge bases are utilized in multidisciplinary research which has advantages over discipline specific type of research. Broader and higher scientific advancement is achieved through the application of multidisciplinary research and saving time plus research costs is better possible with the undertaking of multidisciplinary research. It is also implied that important tradeoffs, interpersonal communication, positive team behavior is highly necessary that needs strong standard operating procedures to be supported. Moreover, the study also finds out that better synergism, insights and higher team spirit is developed through the formation of the multidisciplinary clinical research team that is vital to note. As for the challenges, multidisciplinary team can have issues while taking and integrating information from the different and varied sources that needs to be solved.

According to Bardhan, Chen & Karahanna (2020), the data sharing and data integration is made easy when the multidisciplinary research teams are formed effectively. People, health data and health care systems of different countries are increasingly related and all these areas are to be effectively managed in order to solve the public health problems efficiently. As public health problems are mostly affected by a number of conditions which are mostly chronic and repetitive in nature - long term patient data, record keeping practices should be done properly by the health care workers which can increasingly help the clinical research. The clinical research in the areas of genomics and genetics should be increased in order to improve upon the genetic counseling practices that can prevent the chronic diseases from occurring. Digital leadership is another major area that has been recommended by the researchers of the study. Digital and technological leadership helps in better sharing of data and effective storage of the long-term public health data without any risk of data loss. This in turn, as it can be understood – helps in building of the more robust multidisciplinary clinical research teams. The mobile applications, the social media, wearable digital health tools and watches helps in the better collection of the data for the clinical research and these options have to be properly utilized by the members of the multidisciplinary research team. Technology such as biosensors and also the internet of things has bought a great revolution in the field of communication and information technology and this can be used to collect, analyze data and disclose information of the clinical research findings in more fast and rapid manner (Jane et al., 2018). The researchers of the study recommend the use of structured data from the public health databases, hospital databases and unstructured data from the social media, websites, mobile application equally (Mahmudova, 2019). This will help in yielding better outcomes for chronic disease related clinical research as the public health condition will be better understood with the help of modern-day data technologies and internet. Moreover, using the same technology and digital media platforms are critical for the dissemination of the outcomes of clinical trials at different stages. Public disclosure of the clinical research information is better possible with the digital and internet technology as more audiences will be reached in a short period of time. The multidisciplinary clinical research teams can

utilize data from various sources and come to a common decision about the data analysis that is right is all aspect for the concerned clinical research. The connected data and database systems will also allow the multidisciplinary research team staffs to connect over distance and across the country borders for scholarly research teaching, study collaboration and educational purposes as well. And technology allows a better accessibility to the same vast population and patient data at the same time, thus preventing any type of research risks. The data sharing costs between the researchers of different disciplines will also be reduced with secure and unified digital libraries and clinical research databases. Diseases such as Alzheimer's, Parkinson's disease, stroke, high blood pressure, pulmonary conditions, cardiovascular accidents and asthma plus diabetes type 2 can be much better addressed by multidisciplinary clinical research team, using technology services and digital leadership.

According to Madhan, Gunasekaran & Arunachalam (2018), the research quality in India is poor due to a number of factors. Both the quality metrics and peer review mechanisms in clinical research is flawed in India and the scientometric techniques that are used so purposefully across the globe, are not properly utilized in India. Reward system with respect to the scientific research conducted in the country is poorly designed and not well explained in many circumstances that lead to the problems and complications. The study researchers also point out the importance of having ethical considerations in the scientific research and building strong scientific communities for its advocacy. But in India, the researchers conduct breach of academic integrity mostly and other problems such as breach of ethical parameters in many occasions as well. The supervision, funding support are the areas that are particularly missing from the scientific research scenario of the country. The peer review processes, qualitative and qualitative indicators are not assessed properly by the approval committee members or supervisors that leads to poor quality of research conducted in India. As for a matter of fact, the research evaluation is not that good in India that allows poor quality researches to be conducted over the years, that in actuality lacks value and substance. Moreover, resource planning and proper recruitment of the qualified workforce in research settings is important and competent

workforce is required for the undertaking of complex and critical long-term researches like clinical trials. But the recruitment practices are very arbitrary in India and there is no management science behind it. According to the researchers of the study, it is important to note that the H-index and impact factor metrics are misused in the country that led to presentation of wrong and inappropriate research results. And more so, the actual use of these metrics is not known to many research committees only that cause the problems. Secondly, the research evaluation practices are an ongoing process that does not happens in scientific research forum of India, thus reducing the quality of the scientific researches, undertaken in the country. The scientific projects are not approved based on merits or in the basis on the needs and priorities that cause the selection of wrong scientific research projects to fund. And that shows how the financial or monetary flow is not controlled logically, in India. This also means that the actual scientific research that is of great value to the communities and population of India, are not funded only because they were not approved by the funding committee. Because it not calculated appropriately, the India based scientific research suffer from issues such as the H-index and impact factor syndrome where the weightage of the evidence support becomes problematic. This on the overall, reduces the quality of scientific research conducted in the Indian research institutions and the academic frameworks. According to the researchers of the study, the agencies like Medical Council of India, Indian council of medical research and University Grants commission choose the metrics and indicators in a very random or unreasonable manner that leads to major problems with the clinic research in India.

According to Singh et al. (2018), it is important to note that the cancer is one of the leading causes of morbidity and mortality in India after cardiovascular problems and diabetes mellitus. With the various risks affecting the cancer and pre cancer cases in India, if the assessments and the interventions are not done right, then the numbers are bound to increase rapidly in the upcoming years and decades. Under this amount of major cancer risk, the health care system of India should be well prepared for it which is not the case. The health care system in India is not enough specialized or evolved to deal with the infectious and non-infectious

diseases separately. Systems thinking and surveillance are two major epidemiological tools that are of invaluable importance to public health and its future prediction- based on which the clinical research are undertaken. But in India, as reported by the researchers of the study – there are as less as twenty-nine cancer registries that are hospital based. In addition, there are only twenty-nine population-based cancer registries which is nothing when compared to such a large population of the country. The delay in diagnosis of the cancer cases and the lack of proper qualified clinical workforce who can manage the patients and prevent the disease by eliminating the risk factors – are the serious barriers. The diverse workforce of surgical, radiation and medical oncologists along with palliative care experts, auxiliary nurses are missing from the hospitals, research centers who can care for cancer patients effectively and conduct cancer research. According to the study, adequate infrastructural management, workforce management and proper funding from the pharmaceutical organizations are required. The medical and other healthcare professionals should be properly trained so that they can participate in the translational research. According to the study, more amount of the genetic research, molecular and cultural studies should be funded in order to understand the pattern of development of cancer and hence, controlling these factors will better combat the prevalence of this condition in India. It is also recommended that with better collaboration between the research and academic institutions, between members of the multidisciplinary clinical research team – the cancer research can be realized in India to its full potential. And this is vitally important to eliminate and manage the cancer related population level and individual level risks in the country. Performance management, personnel management as well as financial planning and standardized operating practices are the areas that needs change management with respect to cancer care as well as research in India.

Ghosh (2019) aims to study the major problems that are persistent in the medical research scenario of India and finds out notable results. According to the researcher of the study, about four hundred and fifty colleges are present in India out of which only 6 to 10 medical colleges participate in the actual clinical research conducted in India. The major problems behind this are the incentivizing and funding issues, lack

of coordination between the multidisciplinary research activities and to some extent, due to the lack of right levels of research interest that roots from lack of clinical research awareness. The other problems are the increased burden of patients on comparatively much lesser number of clinicians and professionals. The lack of clinical research guidance and mentorship from the senior clinical research experts are also the major issues. As identified by the research, the undergraduate and post graduate curricula and academic modules in medical sciences and other health sciences are not well developed in the country. And that leads to causation of major risks with workforce development for future clinical researches. As identified by the researchers of the study, a good funding support is imperative to the undertaking of the clinical research for a number of years and decades even and that is why, funding is an important area that is to be addressed and managed well by the research organizations. Flexible and generous funding options should be available to the researchers, research centers and medical colleges so the educational administration, research teaching and the actual clinical research stages are supported effectively. According to the researcher here, a lot of corrections are needed with respect to the medical colleges' participation in the Indian clinical research. Both the central as well as the state governments should become important stakeholders to the clinical researches conducted in India and they should fund the medical colleges effectively and properly to help them build competent clinical and medical research workforce. This will also help the colleges and research centers undertake research works in large amounts. More than sixty percent of the clinical research papers published in the country, are done by the six to ten colleges only which leaves a huge gap in terms of clinical research participation by the medical colleges in India. This is one of major areas that is to be addressed and the governments at national as well as the state level needs to function properly in terms of research funding and development of research laws.

According to Unnikrishnan & Mohan (2020), the diabetes research in India is one the most problematic and underutilized areas that is critical to understand. According to the researchers of the study, India ranks second in terms of diabetes prevalence and owing to that, a number of other lifestyle diseases are also

increasing in the country which is a serious and major problem by far. As found by the researchers of the study, it is critical to note that the numbers of comorbidities owing to this serious clinical condition is contributing to the large numbers of mortality and mortality in the country. This it can be very clearly understood that there is a very high need for the diabetes research to be conducted in order to find out the interventions, management strategies as well as the prevention strategies which will combat the diabetes problem of the country. As found out by the researchers of the study, only about twenty out of the thousands of diabetes care institutions, contributed to maximum number of diabetes research publications in the country. The publications contributed by these twenty research centers was as much as forty percent and the numbers of diabetes research publications peaked between the 2000 and 2009. The social determinants affecting the communities and populations are greatly taken into account in this research study and it is due to economic problems, the major problems pertaining to the clinical research management is caused. According to the study, it is important to note that not only the qualitative but the number of quantitative researches in the field of diabetology are to be undertaken, whose numbers are very less in India. There are many problems that prevent different types of health professionals from entering the research field and this ranges from educational gaps, skills gaps, job security and incentivizing problems. Lack of motivation to enter clinical research due to lack of funds and money and lack of administrative frameworks to support long term clinical research work are seen as the major clinical research management barriers in India. Moreover, as a point made by the study which is vital is that the general practice by the clinicians is perceived as more rewarding than the actual clinical research that is perceived as more tough and stressful. The latter is perhaps the case due to the excessive burden of clinical research works in the government institutions. Lack of skills to formulate research proposals and lack of statistical and mathematical skills in the clinicians are the major barriers that prevent them from entering the full-time career of clinic research. The long-term job security is also perceived negatively due to the lack of clinical research administration and management in the country. Infrastructural issues as well as the resource problems are the major complex problems pertaining to the

clinical research management that results in delays and unnecessary increase in the research expenditures. As for the recommendations of the study, the recruitment of the competent diabetes researchers who have enough experience is important. And supporting them with technical and financial support staffs are all very critical to improve the clinical research quality in India. The clinical research should be advanced by novel ideas and unique research problems so that the unnecessary duplication of the same diabetes research is avoided effectively. The journal publication costs are beyond the financial affordability of normal clinical researchers and this is also to be seen as a major barrier to clinical research work and publications in India.

According to Bishen et al. (2015), there are number of barriers in the areas of dental science and research. The lack of research documentation, deficiencies in terms of funding are the two major problems that act as barriers to the good quality dental research to be conducted in India. The poor quality of clinical research in the field of dental science is also attributed to the fact that the social environment and clinical environment in India is not research friendly and lack of the healthcare plus clinical research administration only deteriorates the matter further. The researchers of the study find about four types of research barriers which are general barriers, time barriers, training or financial barriers and finally the department support barriers. The total number of dental colleges and institutions are more than three hundred in India and despite having such a large number of dental institutions, the clinical research is still in very infantile form in India. High amount of motivation, educational support and also effective coordination between the researchers of different disciplines is needed for accomplishment of complex clinical research activities. Intradepartmental politics is one of the major reasons for workplace conflicts and effective department support as in administration is required for it. Moreover, technical and higher management support are also the departmental responsibilities. As for the training and financial barriers, poor promotional incentives and poor institutional training programs are the factors that create major barriers to clinical research in India. For majority of the clinical research in the field of dental medicine, analytical, statistical and project management skills are needed and there has been complaints from the dental medicine and surgery professionals for not

being trained on it, effectively. The language barriers are another area that needs training as well because mostly scholarly journals publish only English language articles.

Urquhart, Porter & Grunfeld (2011) focusses to study the importance of knowledge brokering in the regulation and maintenance of the multidisciplinary research team. In the multidisciplinary clinical research team, communication as well as coordination is important and a knowledge brokering (KB) position is vital for effective clinical research management. The dissemination of the research findings is a complex work and the collaboration between the decision makers and the researchers of the study is very important. The knowledge broker professional, according to the researcher of the study, can play a very important part in this collaboration and coordination process so that there are no risks in the research related decision making. Lack of coordination and communication between the research workers of the multidisciplinary team leads to delays, wrong calculations, misinterpretations that can impact upon the outcomes of the clinical research, affecting lives of the thousands of patients. In a multidisciplinary research team, there are professionals of different disciplines who takes part and there can be difference between their research skills, techniques and priorities and lack of communication can lead to serious discrepancies and gaps. That is why, it is critical that the knowledge broker professional maintains the communication between the members of the multidisciplinary team so as to promote shared actions, shared decision and interpersonal risk taking. Integration of the knowledge from different disciplines is an important practice in clinical research management and this is important. The knowledge broker professional has a great role to play in the data sharing and data integration process as well. It is the duty of the knowledge broker professional to coordinate technical, managerial and clinical expertise of the multidisciplinary team researchers. Ongoing involvement as well ongoing engagement of the of research members, harnessing their potential, developing shared practices are the main roles of the knowledge broker professionals. The major roles of the knowledge broker professional also include establishing connections with external stakeholders such as the university and clinical departments and care programs. Updating the collaborators and linkages are the critical functions of

the knowledge broker professional as well. Orienting the new trainees on the processes and standard operating procedures of the clinical research is also another very important function of the clinical research team that is important to understand. The knowledge broker professionals can also play a vital role in policy development, research brief development and research showcase event management. Website launch events and new learning events are also be presided over by the knowledge broker professional. Giving the problem solving and feedback sessions to the clinical research experts is very important function of the knowledge broker and moreover, as for employee engagement, coordinating for research funding, calling for papers, electronically updating the deadlines of the deadlines - the knowledge broker professional have a critical role too. Toolkits as well as quarterly newsletters should be used by the knowledge broker professionals in order to develop good communication with the research experts and subject matter experts. Thus, there are number of areas that are to be fulfilled by knowledge broker position in order to improve the clinical research quality.

According to Wiśniewska, (2020), the role of the human resource management is pertinent in the innovation centers. Human resource managers are responsible for the personnel as well as the performance management of the professionals that is critical to note. According to the researchers of this study, it is important that human resource managers should work as an integrator, consultant and auditor that lead to better management and development of the workforce at the innovation centers. The human resource management have four different roles to play according to the Ulrich and Brockbank model of human resource management, which has been explored in this study. According to the model, past roles of the human resource managers included being an employee champion which involves resource department to meet and achieve the needs of the organization. As for another past role, the human resource managers used to act as administrative experts as well where they re-engineer new process and help setup the infrastructure of the organization. The human resource department and its managers also have a great role to play in the process of change management and here, they need to develop skill sets and motivation in the employee, in order to bring about the organizational change, effectively. The human resource managers also act as 'strategic

partners' and it is their role to align the organizational strategies with the personnel development strategies. However, according to the researchers of the study, in addition to the above-mentioned roles, human resource managers have some additional roles to play as well. The new roles of the human resource professionals have evolved over time and one of the new roles directs human resource managers to act as employee advocates where they need to support and listen to the staffs while representing them. Human resource managers have a great role to play in the development of human capital and leadership capital so as to address the needs of the company in future. Being a functional expert, they need to provide training and retraining to the staffs, in order to develop their skills and knowledge that is again required to run the organizational processes. The role of human resource managers to act as a strategic partner remains the same. Human resource managers should be managing and branding the staffs strategically, in order to meet up with the company's goals and external strategies. The human resource managers need to act as 'leaders' as well where they need to lead the staffs and employees of the organization so as to meet the organizational productivity needs. They need to create values for the staffs while they are working in the processes, and this would keep the employees engaged to their work and motivated at well. That is why, the researchers of the study, encourages the human resource managers to adhere to their old as well as new evolved roles in order to make most use of the resource plus workforce and drive organizational success in an effective way.

According to Albrecht at al., (2015), the human resource management can play a very major role in the development of the employee engagement and to increase the company performance as a whole. According to the researchers of the study, it is vital to note that the organizational and group performance as well as the competitive advantage of the organization is dependent on a number of factors. And one of the most important factors is employee engagement. The engagement of the staffs at the organization is affected by a number of factors as well such as availability of work, meaningfulness of the work being done on a daily basis, psychological capital and psychological safety, job resources and the demand of the job in the market. The organizational climate as well as the environment of the work place has been found to impact

the engagement of the workers at a great degree. According to the researchers of the study, the different areas of the human resource management practices are practically meant to be dealing with the employee engagement and ensuring fulfillment of their job roles and the key responsibility areas. The human resource management practices are training and development, performance management, socialization and the right hiring practices for personnel selection. According to the researchers of the study, the human resource managers should be analyzing the personality of the staffs and then align them with job and organizational context, individually. Another very important human resource function is to motivate the staffs of the organization and again the individual traits should be understood and assessed before motivating them one-on-one or group wise. By doing personality assessment, the traits such as self-discipline, optimism, proactivity, self-efficacy, conscientiousness, openness to experience, social potency should be analyzed and this will help in the prediction of the staff performance and engagement. Another very important role of the human resource management team is to better the relationship between the employer and the staffs by strategically aligning the processes and systems. And the betterment of the relationship between the staffs and their employers were found to be positively impactful on the competitive advantage of the company, in the market. Setting up a system of feedback and appraisal by the human resource department is critical to the development of the engagement of the employees. As for the training and development regimes, the human resource department should focus on improving upon the personal mental resources of the staffs like the emotional management and work management abilities. The human resource managers should also provide enough job resources to the staffs so as to motivate them and also improve upon their self-efficacy. The personality traits such as the emotional stability, extraversion and conscientiousness should be maximized and improved positively by the human resource management. And this can be done by allowing the staffs to take up personal projects and empowered professional actions that adds to their job crafting, developmental and learning abilities. These human resource actions will help in the encouragement and engagement of the staffs and add to the holistic ‘gain spiral’.

Jeanguenat & Dror (2018) aims to study the stress levels of the forensic scientists in clinical research. The stress levels of the clinical researchers in this field are affected by several factors that are very much industry specific such as zero tolerance policies, error free processes, legal system that is adversarial in nature, horrific experiences and negative experiences of murder and crime events plus scenes. These experiences are so repetitive and traumatic at times that it affects the psychological safety and emotions of the clinical researchers in the forensics field. Moreover, it is critical to note that the lack of funding and increasing incidents of technique criticism actually leads to building of stress and anxiety as well, in the forensic field. There are a number of factors that affects the decision making and work in the forensic research and these are cognitive architecture of the scientist, training and motivation, organizational factors, base rate expectations, irrelevant case information, reference materials and case evidence. On broader classification, these factors can be again classified into human nature factors, experience, culture and environmental factors and case specific factors. Industry pressure, stakeholder pressures as well as the performance pressure affects the stress and anxiety levels of the forensic researchers and leads to decrease in the work performance. The other factors such as increased pressures of legal opposition, job insecurity because of high competitions also adds to stress and burnouts in the employees. The position and the hierarchies of the staffs are another set of problems and lack of organizational support leads to the development of negative stress as well. The sleep quality is reduced and the emotional dysregulation is increased as a result of regular stress and anxiety, faced by the forensic scientists. The stress can also lead to development of the high blood pressure in the clinical researchers and this ruins the health safety considerations at the workplace. On the long term, the health and wellbeing of the forensic researchers are impaired and this health safety of the scientific researchers is a major concern that is to be addressed in an effective manner. That is why, it is critical to note that the mindfulness training is one of the major interventions that has been recommended by the researchers of the study. Internal communications such as meetings, emails should be used regularly to in order to improve the employee relations and to set research priorities. The communications regarding the mindfulness exercises,

techniques and the workplace programs should be clearly provided to the forensic scientists in order to develop a supportive and healthy mindfulness culture. This workplace intervention has been found to be reducing the rates of absenteeism and increasing job satisfaction, employee involvement and retention. The stress reaction management is one of the core areas of workforce management and to manage the scientific workforce in clinical research settings, stakeholder and internal communications are effectively needed to be aligned. The human factors and the environmental factors are the major areas that needs to be addressed in effective manner in order to reduce errors and to improve productivity in a safe manner.

According to Meador (2015), there are serious issue regarding the clinical research with respect to the type of the research centers where it is undertaken. According to the researchers of the study here, there has been a gradual decline of clinical research undertaken in the academic centers. According to the researchers of the study, there has a rapid decline of the same in the middle of the 1990s due to decrease in revenues earned in the clinical care settings. That is why, the pressure was put on the clinical researchers to work more in the hospitals and clinics in order to raise the revenues for the government. This caused most of the academic clinical researchers to shift from the research work to the clinical settings, in order to fulfil their duties. Another important information mentioned by the researchers of the study is that National Institutes of Health (NIH) funded the translational and the life science researches much more than the clinical researches that lead to serious gaps. Other than the funding issues, the skill sets of the clinical researchers were a serious problem that was more so aggravated by the unsupportive academic environment in the medical university settings. According to the researchers here, there is a need for high educational support for research skills development of the young faculties, research professors, fellows, residents and even students that is vital to note. According to the researchers, the Doctor of Medicines (MDs) do not possess the right amount of the skills needed to conduct clinical research and investigator-initiated research. This leads to medical equipment and biopharmaceutical companies investing the most in clinical research and this causes professional conflicts, administrative issues and other stakeholder management problems. The NIH

funding is affected by the rising research costs and the inflation problems. It is primarily due to the lack of the academic center's involvement, the major gaps with MD training occurs. There are a set of instructions that are given by the researchers of the study, in order to improve upon the clinical research quality and quantity. At first, the medical universities should roll out clear set of public policies with which they want to improve and monitor clinical research. Secondly, the medical universities should be focusing on learning and development of the students through effective research training and the curriculum should also require them to conduct clinical research. Thirdly, accreditation of the colleges and registration of the students as professionals will require mandatory clinical research methodology training. The academic and the clinical faculties should be involved with the mentoring roles. The requirement for the clinical research projects and training should be made mandatory as a component of residency training. The federal government and the NIH should be having a better and effective incentive structure in order to motivate the medical universities and their staffs to take up the clinical research. Indirect grant funding should be encouraged more and more amount of the philanthropic funding is required alongside industrial funding in order to achieve the clinical research goals and support the clinical researcher's career. Outcome evaluation is critical to understand the impact of the undertaken clinical research. Routine monitoring to assess the quality and findings of research is important in order to make the clinical interventions more research informed and evidence based. Lastly, it is important that auxiliary staffs should be hired in proper numbers so that they can help the physicians with the electronic data entry, documentation and file management processes, thus allowing the latter extra time to undertake clinical research. Hiring them with reduce the labor costs and the burden of the patient care as well.

According to Grossman (2016), there is a high requirement for a multidisciplinary approach to be taken in clinical research, especially in serious cases of public health problems like acquired immunodeficiency syndrome (AIDS). The multidisciplinary collaboration is required at the economic, ethical, behavioral and social level in order to irradicate this life-threatening public health problem the society. The biomedical

researchers as well as the social scientists needs to collaborate into a multidisciplinary team so as to improve the outcomes of the clinical research, in the domain of HIV cure. According to the researchers of the study, there are number of areas who's proper addressal means improvement of the quality of the clinical research. At first, understanding the hopes, beliefs and the preferences of the clinical researchers is important and so is the understanding about the contextual and social determinants of biomarkers. Checking the participant's willingness and taking informed consent is critical to the right undertaking of the multidisciplinary clinical research. The misconceptions between the curative and therapeutic interventions in AIDS care should be cleared out with the help of the ethical as well as the social analysis. It is very highly important that the patient centered care and shared decision making is promoted in this multidisciplinary AIDS research. Partnering with the patients and with the family of the patients is highly critical and this is to maintain the safety during the clinical research work. The public health promotion campaigns should be planned alongside the clinical research and the aim should be to improve the community and public perception about health science and AIDS research. The policy research, implementation science should be improved upon in order to improve the outcomes of the clinical research. Other than this, it is also important that financial management is done properly in order to reduce the unnecessary costs. Public involvement, social medicine, critical ethical considerations, collaborative decision making are the critical components of the clinical research. The relapse costs and rates are to be calculated properly so as to support the patients with reduced costs and research informed decision making. All these factors are critical to be addressed in order to improve the overall quality of the AIDS related clinical research.

Mårtensson et al. (2016) aims to understand the different aspects and the benefits of the multidisciplinary approach to scientific research. According to the researchers of the study, the concepts of 'situated learning' and 'learning in action' are the major components and contextual factors that impacts the undertaking of the multidisciplinary research. Both social constructivism and realism are responsible for balanced scientific research to take place, and this forms the foundation of the multidisciplinary research.

The researchers of this study focus to understand the importance of quality evaluation of a scientific research and there are a number of dimensions against which the quality analysis is to be done. There are certain contexts that are to be analyzed and understood before. At the very first, the national systems and the boards responsible for the production and monitoring of scientific evaluation in the country is to be analyzed. If the national framework of the science and research is not strongly built enough, that will impact upon the quality of any scientific research undertaken in the country. The second context is the infrastructural quality of the research center and institution. The third context is the group conformity of the research constellations and groups. The fourth factor is the research topic that is being chosen and to what extent, it is purposeful, significant in the modern scenario and the factors that comes to play as well. The fifth factor is research publications and manuscripts, and the last contextual factor is the research grants applications. While all these contextual factors help in understanding of the quality of scientific research work in indirect ways, there are certain number of direct factors that gives much clear idea about the quality and substance of the undertaken research. These direct factors are also the areas where the quality control and assurance activities must be undertaken without any kind of misses. The number of guest scientists and researchers, the PhD thesis numbers produced by the university or institution or college, the number and amount of the research grants allowed internally by the organization - are the major serious indicators of the quality of the scientific research. The other factors are the size of international and national science research networks, the credibility of the researchers as in the academic qualifications of the scientific researchers themselves. Lastly, it is very important that the publication measures are taken into consideration that reflects on impacts, quality and scholarly stance of the research. As for the research constellations undertaking the scientific research, there are several other parameters that comes to play while analyzing and scrutinizing the quality of the scientific research. The socioeconomic significance, the clinical, technological and the scientific significance is taken into consideration in order to perform the quality and outcomes evaluation of the scientific research. There are a number of factors that can actually increase the costs of the research and these factors can be internal

and external to the actual research undertaken. The lack of workforce planning and management leads to excessive costs and so is the lack of technology use for data collection and integration. That is why, the Italian national research board gives clear set of directions and guidelines to evaluate the clinical research which includes understanding the resource management, resource attraction and finally the socioeconomic impact. These factors also determine the viability and reproducibility of such research in the future and even in modern circumstances. According to the National Institutes of Health (NIH), United States – there are 5 components or aspects based on which the grant allowance is made, and these are research environment, research investigators, research innovation, approach and significance. All these five factors are highly critical to understand the quality and importance of the research in the context of modern day needs and circumstances and that is why, these indicators are to be greatly assessed before allowing the grants.

Cumin et al., (2013) focusses to understand the importance of multidisciplinary team training. According to the researchers of the study, it is highly important that the surgical care and research is enhanced by training the multidisciplinary care teams in most effective manner. The operating room simulation training should be used in order to improve upon the non-technical and the technical skills of the multidisciplinary team members and mostly, a crisis scenario was simulated in order to develop the right type of skills and mindset in the clinical team members. Virtual technology mediated training was used in the researches in order to develop crisis management skills in the team members and also to develop employee engagement to the patient care and research process. There were many articles reviewed in this study which provided evidence in favor of simulation training and it was reported to be useful for learning and development of the staffs. However, the use of this technology did not offer much help to the development of risk management skills in the clinicians and others, according some to some articles reviewed in this study. This is so because the technology that was used in the training process lacked the physiological and anatomic indicators that are critical for saving of a patient's life in surgical scenarios. That is why, there is a high need for human resource training-based researches to improve upon the technology mediated simulation training modules in

surgical settings. The perceptions of the staffs play a major role in the success of the research training programs and this was important findings of the study. There are a number of critical barriers to the undertaking of the operating room-based simulation training and these are cost of the technology, surgical models fidelity and recruitment problems. The hospital management and the senior staff recruitment related problems has been found to cause the major issues with training and employee engagement. The standard operating protocols regarding the undertaking of the mandatory training for professional development, is critical for the learning and development of the multidisciplinary surgical team members. And there should be more research undertaken in this area. Other than proper recruitment and resource management interventions, according to study, the safety checklists as well as the policy modifications are critical to the development of safe crisis management. And this should be an integral part of the clinical research and best practices implementation.

Holmes et al. (2020) focusses to understand the importance of multidisciplinary teams and multidisciplinary research during the pandemic situations. The collaboration is extremely important to order to manage the growing cases of mental health issues during the pandemic crisis that is vital to note. The socially diverse groups are mostly affected with the mental health issues that is vital to note as well. The multidisciplinary research and care options has been found to be very effective in neuroscientific ways, social and psychological aspects, according to the researchers of the study. Multidisciplinary research developments are required in the areas of unified database development and shared data tracking. Respiratory medicine, intensive care medicine, virology, neuroscience, psychiatry and psychology are the disciplines that needs to collaborate for the multidisciplinary research work and to manage the mental health crisis during the covid 19 pandemic situations. There are various types of benefits of conducting multidisciplinary research and these are - more robust policy development, informed choices, treatment adherence, screening, prevention and reduction of any kind of risks. The formation of research groups and keeping up a good communication and coordination, is vital, according to the researches included in the study. Social messaging

and health messaging is important as well and the researchers here focusses to communicate the idea of technology leadership in this study.

Methodology

Research philosophy – This is management science research that focus on interpreting the social world and the human elements that play a very pivotal role in the development and regulation of the clinical research teams. That is why, in order to understand the human factors and socio-scientific aspects of the clinical research management, an interpretivist research philosophy has been undertaken (Ryan, 2018). The belief that instruments, shared meanings, consciousness and knowledge is actually socially constructed and they can evolve, with in-depth scientific research works – is what has been utilized in this management research study. There is a very high human involvement in clinical research and its management. That is why, this research philosophy has been chosen.

Research approach - As it can be very clearly understood that the research problem area is not clearly researched or well defined before, that is why, an explanatory research approach has been used in order to explain the exact problem areas, the solutions and the interventions in an effective manner (Clarke, 2015). There are different perspectives to the problems, designs and the solutions with respect to clinical research management in India and across the globe which are on different dimensions. And that is why, there is a very need to connect the varied concepts and explain the gray unsolved areas with respect to multidisciplinary clinical research, overall research quality and the effective management strategies. That is the reason behind the choice of this research approach for this study.

Data collection

As there are number of gaps in the scientific literature in relation to research problem dealing with multidisciplinary clinical research risks and its management, there is a need to have an in-depth analysis of the more focused research works. That is why, systematic review has been chosen as the data collection method.

Selection criteria

Electronic databases such as the PubMed, Medline, ScienceDirect, Cochrane has been searched in order to find the scholarly articles that relate to the core research problems and research purpose.

Keywords used - 'clinical research', 'clinical research management', 'clinical research problems and risks', 'diversity management', 'workforce management', 'multidisciplinary research', 'research quality evaluation'

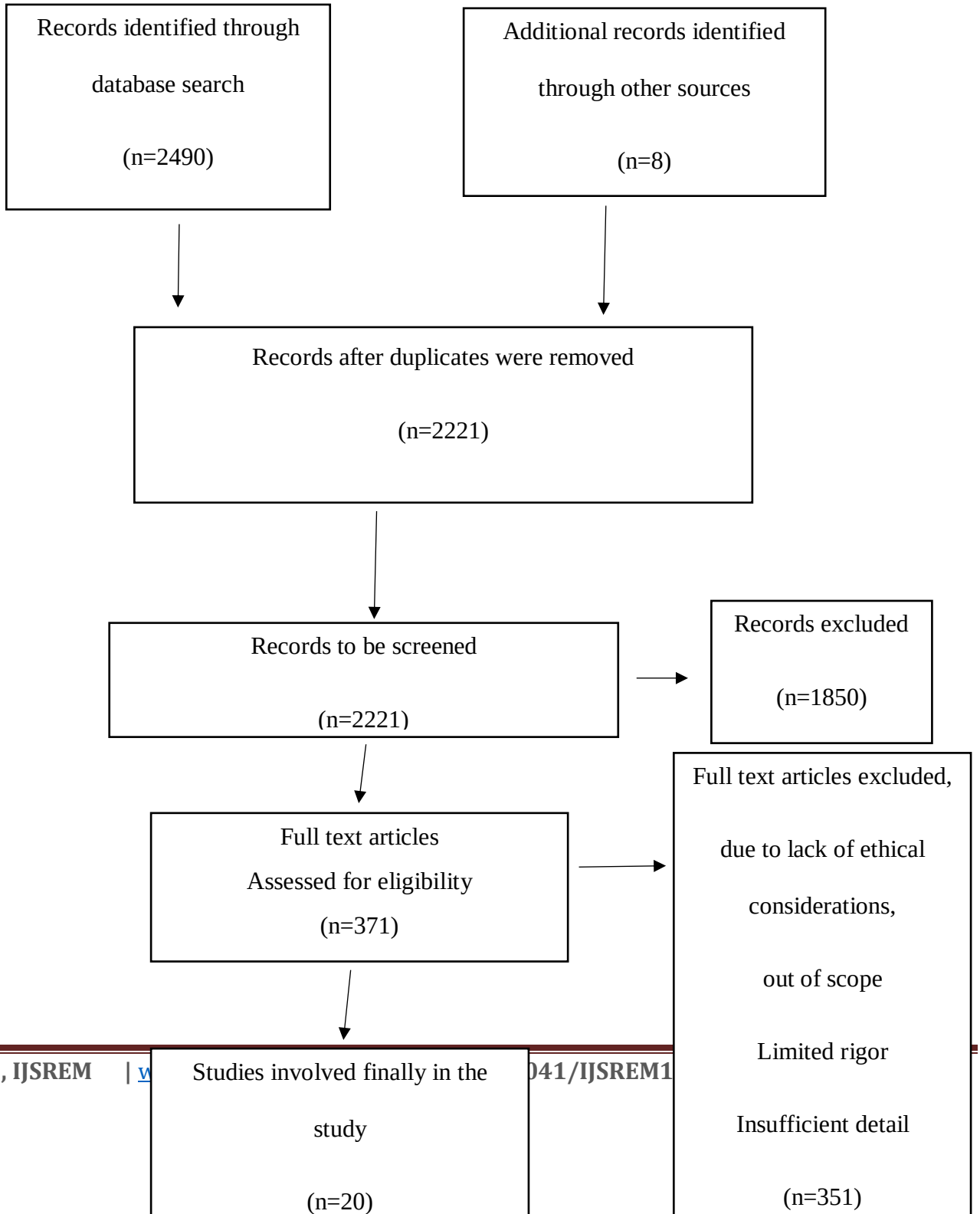
Inclusion criteria

1. Articles are published not more than 10 years ago.
2. Articles are peer reviewed
3. Articles are published in English language journals

Exclusion criteria

1. Articles are published before last 10 years
2. Articles are not peer reviewed
3. Articles are not published in English language journals

PRISMA chart



Article name	Author and year of publication	Methodology	Sample	Findings
1. Participant retention practices in longitudinal clinical research studies with high retention rates.	Abshire, et al., 2017	Semi structured interviews and thematic analysis	22 studies	Longitudinal studies often face the problem of participants leaving the research work due to its long-term nature and also due to their lack of interest and lack of feelings of purposefulness. Just like the employee retention, it is also very important to support and retain the participants which is the main focus of the study. There were four themes that were found out as result of data analysis and these organizational strategies are scheduling/contact strategies, emphasizing study

				benefits, characteristics of the study visits and finally, the study reminders. As per the researchers of the study, continuous innovation as well as adaption is required for the retention of the participants and employees. Culturally competent culture and cultural sensitivity are the factors that positively affects the participant retention rate and also organization of the research teams. Tailoring of the retention strategies is also very much critical in order to retain both the staffs and the participants, as found out by the researchers of the study. The role of the staffs that is the clinical researchers is also very important to the retention of the participants. The recruitment of highly skilled workforce who knows how to contact and communicate with the participants even in a long-term

				scenario – is vital. Incentivization is another important strategy, that is mentioned by the researchers of the study to be very useful for the participant retention. Funding from the federal government, workforce training and also proper resource allocation are the major factors that affects the retention of the participants in long-term clinical research. Moreover, the budget allocation for developing the different types of the participant retention strategy is also very critical to be decided upon by the organization and its management. Participant communications can be better done through digital media, social media and that is why, technology use has been emphasized upon by the researchers here.

2. Clinical research training and capacity building for prevention and control of non-communicable diseases	Mohan et al., 2017	multi-pronged approach	3,650 participants	Capacity building and resource allocation to the clinical research frameworks is very important and this has been the focus of this article. The rate and the prevalence of the non- communicable diseases in India is very high and is a serious public health problem that is critical to understand. According to this study, the resource allocation and research capacity should be increased in order to develop a proper and competent clinical research team. The importance of the multidisciplinary collaboration has been highly emphasized upon by the researchers of the study. The multidisciplinary collaboration between the clinicians, physicians and the scientists has been given much importance. The multidisciplinary coordination and collaboration between the

				implementation sciences, clinical, genetic and basic sciences is important in the same way in order to improve the clinical research quality in India. It is to be understood that along with the research capacity building approach, the research related training is also extremely important and there are multiple training methods that has been used in order to improve the research skills in the clinical researchers. National seminar, intensive interactive training course, in house workshops, genomics workshops, video conferences, short term international training, medical college and institute-based workshops and the seminars, national workshops for the teachers and professors – were the different training and skills development techniques used in order to develop

				the needed skills in the clinical researchers. Face to face teaching, video conferences were used in the research training process that is critical to note. Other than this, mentoring of the candidates taking part in the professional and research training and giving them assignments to complete, were the different techniques used to develop the right skills sets and learning in the clinical scientists. This overall impacted positively upon the improvement of research quality and safety. Both the technology leadership and the training capacity of the institute has been emphasized upon here, by the researchers of the study.
3. Vascular surgery and the multidisciplinar	Diaz 2020	Experimental study	Pre-clinical and clinical	According to the researchers of the study, the vascular surgery outcomes can be improved with the undertaking of the vascular research

y vascular research team				on a continuous basis and by informing the practices, with updated policies and guidelines. It is important to understand that the vascular research team should be very much diverse and a number of different professionals from different disciplines and subdisciplines should be part of it. Basic scientists, vascular biologists, chemists, educators, statistician, engineers and clinical trialist are the core members of the vascular surgery research team, according to this study. Other than this, it is also very important the allied health professionals like the podiatrists, physiotherapists, technicians, psychologists, physician assistants, nutritionists and social workers – are included in different stage of the vascular research as they come useful in the pre-operative and post-

				operative phases. The regulatory body and the organizational management also have a very active role to play in the workforce management.
4. State of the art: toward improving outcomes of lung and liver tumor biopsies in clinical trials	Levy et al., 2020	Conference discussions based on cases studies	Evidence points	For better biopsy practice outcomes as well, a large number of critical team management, data sharing strategies are required. The multidisciplinary collaboration between the pulmonologists, pathologists and the interventional radiologists are of extreme importance. Other than this, setting up of the appropriate standard operating process and creating the strong standardized protocols for regular documentation practice compliance is critically important at the same time. The information technology specialists, the study coordinators, the research scientists and the clinical scientists are all very

				vital members of the clinical research team. Radiologists, surgeons, telepathology experts along with the oncologists are critical components of the multidisciplinary clinical research team as well. In this study, the importance of information technology inn better communication development has been emphasized upon – to a great extent. Genomic scientists and data scientists are also critical resources who can assist in the clinical research processes. Guideline compliance and documentation practices by the members of the multidisciplinary team is very much vital as well. Data management is also very important as data is to be shared between the molecular, radiographic, pathologic and clinical

				science disciplines in a fast and secure manner.
5. Real time presence of a microbiologist in a multidisciplinary diabetes foot clinic	Paisley et al., 2012	Case report	1 (62-year-old diabetic man)	As diabetes mellitus is a long-term condition, it is important to note that both medication as well as non-medication management is important. And that is why, in the clinics, a multidisciplinary collaboration between the diabetes and vascular specialists is very much cardinal to improve upon the quality of the research. According to the researchers, it is important that the medical microbiologists and the biomedical scientists are also included in the appropriate proportion in order to improve the quality of the clinical research in the country. The researchers of the study find out that the presence of the biomedical scientist in the team benefits upon the study in many ways. The safety, efficacy and also

				the quality of the research is improved in a very great manner due to the inclusion of the microbiologist in the multidisciplinary clinical research team. The multidisciplinary clinical research teams also should consist of the auxiliary staffs, the diabetes specialist nurses, orthotists, podiatrists as all of them can equally contribute to the different stages of the diabetes related foot ulcer research. The presence of microbiologist is particularly important for understanding virology and bacteriology plus infection control related problems.
6. Academic, foundation, and industry collaboration in finding new therapies.	Ramsey et al., 2017	Narrative review	36 articles	According to the researchers of the study, in order to research the conditions and diseases like Mutiple myeloma, cystic fibrosis, diabetes mellitus and also multiple myeloma – the industry and the academic institutions should be partnering up.

				Together, they can find out results and positive clinical outcomes in a faster manner. According to the study, the human resource management and performance management is more critical to drive towards new innovations in clinical research rather than just financial planning. The disease specific experts, disease focused foundations, academic medical foundations, industry partners, the government agencies are the most vital stakeholders who needs to collaborate well in order to develop positive clinical research outcomes. Thus, effective stakeholder management and also stakeholder communications has been implied in this study. The preclinical, clinical programs as well as the different types of the screening processes used in the clinical trials and clinical

				research will be better done through this many-way collaboration. According to the researchers of this study, the level of regulation and regulatory compliance in modern times has increased very much and at the same time, the funding and incentivization for the drug development, basic research and preclinical research programs has reduced very much as well. That is why, the multidisciplinary and institution level collaboration between academies and industries plus agencies are needed.
7. An audit of minutes of Subject Expert Committee meetings as a metric to assess the clinical research	Shetty et al., 2019	Retrospective cohort study	Data between 1.7.14 to 31.10. 2017 was assessed 317 meetings n = 2030	The clinical trials need to be funded and that is why, a lot of marketing activities, strategic marketing planning are needed. The marketing activities again needs to be authorized by the right concerned persons of the organization. Drug development and drug distribution

roadmap of India.				plus drug sales needs a lot of marketing activities and only few divisions like the ophthalmology, vaccine and oncology have been reported here to be controlling these processes predominantly. According to the study here, the contribution of India to the global clinical research is very low. While 60 percent of the clinical trial applications are developed and marketed by the pharmaceutical companies of Indian origin, the high quality applications that are imported from other countries are very less and this is impacting the overall quality of clinical trials and its marketing. The academic institutions contribute to about 5 percent of the total clinical trials only. The lack of funding becomes a major roadblock for them and that is why, the pharmaceutical companies need to back these academic institutions, thus indicating the importance of the

				academic, industry collaborations. In many cases, the marketing approvals were requested for and in many cases, it was not but in most of the cases when it was requested, it was denied without any valid reason. That is why, a very standardized protocol should be followed across all the departments, which is the main recommendation of the study. The standardization of the protocols would help create transparency through the step-by-step decision-making process.
8. Electronic health records to facilitate clinical research.	Cowie et al., 2017	Narrative review	50 articles	The electronic health records also known as the EHR play a major role in the facilitation of the clinical research. The proper utilization of the electronic health records allows seamless and productive data sharing plus stakeholder engagement between the patients, policy makers, regulatory bodies, industries, academia and other EHR

				vendors. The study implied and indicated upon the effective data management and time management that is possible with the application of electronic health records. According to the researchers of the study, the use of technology in an effective manner also helps in financial savings in the clinical trial framework. Data quality, authentication level is better with respect to the electronic health records as compared to the manual documentation. The other benefits of using this technology in clinical research involves better multidisciplinary collaboration, better privacy and data security, more analytical plus data storage capabilities.
9. Academic engagement and	Perkman n 2013	Systematic review	36 articles	According to the researchers of the study, the academic researchers of the study have a very major role to

commercializati on				play in the clinical and public health field. And their roles consist of publications, teaching, consulting and others. In order to commercialize them effectively, grant support, publication support, academic practice support should be provided along with the work life balance and work engagement support. Providing them with better teaching opportunities and entrepreneurial opportunities is absolutely critical as well for commercialization and betterment of the overall research quantity and quality. The academic scientists should be supported with the independent patenting as well and this will help greatly in their commercialization. In order to build up all these supportive activities, the revitalizing of existing policies and the creation of new policies to

				support this research promoting and commercialization activities is very important. Online and offline surveys are important to understand the needs and positions of the academic scientists, researchers in the current research framework. And then based on this, the right interventions can be developed to help them exactly. Technology leadership and database management has been emphasized upon deeply in order to develop and maintain a connectivity between a large group of academic scientists.
10. Diversity in clinical and biomedical research	Oh et al., 2015	Narrative review	49 articles	This research is important as it covers and focusses on very big issues and that is of social injustice that is often affecting the quality and the outcomes of the clinical research. The participants from all the populations are not chosen properly and they are left out

				because of social discrimination, injustice and this is a serious issue. The inclusion of culturally diverse groups is avoided generally due to elevated research costs but conducting different clinical research every time for a different social group increases the costs to higher extent. That is why, the need for diversity management and diversity inclusion is imperative and social and cultural issues has to be managed properly at first. Fear, racial discrimination, transportation issues, stigmatization, economic problems have been found to be very much the problem here. That is why, nationwide cohort population studies, workshops, incentivization and culturally competent practices from the researchers are the main interventions that can result in more diversity in the clinical research.

				Diversity related policies should be developed and laws should be enforced in order to bring about the actual change. Moreover, the communication and openness towards more diversity in clinical research should be developed through discussions in classrooms, board rooms, study sections and as in between the faculties.
11. Fast-track surgery– conditions and challenges in postsurgical treatment.	Hoffmann & Kettelhack 2012	Systematic review	71 articles	Recovery after surgery or post-surgical recovery is a major problem and complex issues under many circumstances can arise due to the level of risks and complexities involved. According to the study, more translational researches are required in order to inform the surgical practice and post-operative care practice protocols. As per the results of the clinical research conducted, new drug development, goal-directed fluid therapy, new

				analgesic use is highly recommended.
12. Management strategies in surgical research	Chung et al., 2017	Narrative review	3 articles	The team building problems, cultural conflicts and social differences as well as the lack of accountability leads to the development of gaps in the clinical research and its outcomes. That is why, it is important that the management strategies should be applied in right ways. The creativity and innovation issues, the leadership and the responsibility taking behaviors are the areas that needs to be managed with the strategic team management and resource allocation. In surgical research management, the cardinal areas of strategic management require development of safety culture, a unified team culture and creative leadership within the team that is vital to understand. Productivity

				management, effectiveness maximization are the main aims of the surgical research management. Improving the experiences and the feelings of the staffs about their work in the multidisciplinary surgical research team is very much cardinal as well.
13. Best practices for enhancing surgical research	Sener et al., 2019	Narrative review	23 articles	The researcher studies the main problems with the surgical research in Canada. The surgeons at practice do not comply with the research informed practice protocols that affects the quality of life of the patients. Thus, compliance issues are the most important ones that are to be noted here. The funding agencies in the country of United States as well as that of Canada based their disapproval and disallowances on the fact that surgeons are not capable scientific research and they lack the potency

				of conducting the scientific research. The leadership support is not provided as well that leads to the development of serious problems with respect to the surgical research. The first solution identified by the researchers of the study is the development of infrastructural support for surgeon researchers. Grant writing workshops and internal review panels are critical to receive the necessary funds required for the infrastructural development. The collaboration between the residents, scientists, surgeons should be developed by the departmental research committee, according to the researchers of the study. It is also important that resource sharing and knowledge sharing is done between the different clinical departments so as to improve the outcomes of the clinical research. Secondly, it is very important

				according to the researchers here, that the social network plus the mentorship should be developed in order to improve the quality of surgical research. There are four major areas that has to work together for this which are surgical innovation, patient centered research, surgical education and big data. These are the four major strategic areas that the research university and organization need to focus on, in order to drive profits and support the surgical research for a long term. Time management is a serious problem for the stakeholders of the surgical research. And that is why, according to the researchers of the study, it is very much important that the discussion groups are formed that discuss ad solve the problems around research remuneration, on call schedules, teaching responsibilities and also clinical load. The retention,

				hiring and recruitment of the clinical and surgical scientists are a great problem and this is due to the lack of salary, incentivization and funding support. The multidisciplinary collaboration between the residents, surgeons, anesthesiologists and scientists is important. Hence, according to the researchers of the study, salary support, time support and resource allocation are the areas that needs to be addressed here in order to improve the overall quality of surgical research in the country. The new approach and new operating practices should be developed using the translational type of clinical researches that is at a better position understanding the immunological, humoral and the inflammatory responses. A multidisciplinary collaboration between the general practitioners, outpatient care, physiotherapist, nurses and

				anesthetists has been recommended here. All these strategies as mentioned here, are very much important to understand.
14. Surgical tray optimization as a simple means to decrease perioperative costs.	Farrelly et al., 2017	single-site observational study	5 pediatric surgeons	According to this study, the operational measures in clinical and surgical practice is important in order to reduce time, costs and to increase productivity. The surgical research mainly focused on reducing the number of surgical instruments placed in the surgical tray so as to reduce the processing time and rotation time and this was highly useful to reduce the overall hospitals costs. Optimization of the tray reduced labor costs and also materials costs. Change management and training of surgeons and other operating team members is important. Micro environment management has been focused upon here, to improve surgical research care.

15. A human resource management review on public management and public administration research	Boselie et al. 2021	Systematic review	77 articles	This study focusses on the importance of human resource management to improve the public health conditions in a very proper way. In this study, the importance of performance management, employee health and safety along with wellbeing management has been explored and how human resource management can actually control and manage all these aspects with the clinical research staffs. In the clinical research framework, the human resource management has a number of roles to play like in development of job design, good employee relationships, team work, employee autonomy and others. The pay and appraisal based on the staff performance, training and development, workplace socialization, selection and recruitment of the right candidates

				are all vital functions of the human resource managers. The behavioral management of the staffs such as development of organizational commitment and job satisfaction, affective commitment and positive attitudes is also their role. In the public health research framework, the roles of human resource management focus on motivation and performance management of the researcher staffs plus the others as mentioned above.
16. Aims of homeopathy research, 1994 and 2015	Righetti 2015	Narrative review	3 articles	There is a very high need that the clinical trials in the field of homeopathy is increased to a great degree so as to improve validity and reliability of the interventions. There is more than 200 years of clinical experience but not enough clinical trials in the field of homeopathy. And this research gap is a major disadvantage for the field and the

				profession of homeopathy that is vital to understand as well. Funding and the financing problems to support the homeopathy researches is a major problem and so are the problems regarding accessibility to university. The media critics also create enough problems for the homeopathy profession and research and that is why, it is very much vital that the basic researches are undertake properly in order to support the homeopathy profession. Again, multidisciplinary collaboration and diversity in the research are required in order to promote the authenticity of the homeopathy profession and practice. As the patient base of the homeopathy is still very high even in the modern world, the research practices and financing of the homeopathy trials is vital and

				imperative as well. Just like the medical practice, more evidence-based practice is required in the field of homeopathy and that is the reason why, more and more clinical research is needed here as well. The importance of experimental studies as well as the preclinical studies is very high, so as to provide support to the clinical trials undertaken in homeopathy field.
17. OB/GYN Resident Research Curriculum	Worly 2017	Critical review	471 abstracts plus 4 articles	The obstetrics and gynecology residency physicians lacks the practical research skills and that is why, according to the study here, there is a high need to train them. The research programs should have the right members and stakeholders which includes the Resident Research Program Director and faculty mentors. They play a major role in upskilling of the residents and in their training as well. The

				research funding, protected time for the residents to conduct the research, a structured curriculum development is very critical for effective clinical research and training management of the residents. Research training is one of the major areas that has been highlighted by the researchers of the study here as because the future physicians who are to conduct clinical research must know the right research concepts and have the right form the skill sets to undertake it, successfully.
18. Translational physiology: from molecules to public health.	Seals 2013	Narrative review	45 articles	According to the researchers of the study, it is very important that the translational researchers from the field of biomedical sciences like physiology are recruited in the clinical research. The molecular and functional researches conducted by physiologists have a great

				importance in the progressing of the public health outcomes in a more positive manner. More research enterprises and the research programs should be formed so as to help the translational researchers from the field of physiology contribute to the public health in a better manner. Based on the laboratory based physiological researches, the public health policies by government and practice guidelines in clinical setup can created and modified accordingly as well. Again, an academic, systemic and industry relationships have been emphasized over here. Developing a research culture through education, research career development and technical skill development approaches, highlighted journal series, broadening the role of human resource departments, preclinical

				data integration and strategic management of core laboratories as well as multidisciplinary collaboration has been found as effective solutions to the roadblocks. Reward and recognition to the excellent performers is also very important to improve job satisfaction, prestige levels and autonomy.
19. Developing multidisciplinary clinics for neuromuscular care and research.	Paganoni et al., 2017	Narrative review	71 articles	According to the researchers of the study, it is very important that the multidisciplinary research is conducted in order to improve the outcomes of the neuromuscular diseases through the application of research informed interventions. According to the researchers of the study, the care coordination, quality of the patient care is all bettered through multidisciplinary neuromuscular research. The multidisciplinary clinical research

				should be conducted through the collaborated actions of genetics, orthopedics, pain clinics, mental health, palliative care, hospice care, pulmonology and cardiology departments. The members of this respective department should be part of the multidisciplinary research team. For the proper care and research management, the technology and stakeholder communications plus management are very much important. The patient portals, newsletters and the websites, philanthropic and social marketing actions, advocacy groups surrounding a certain disease condition or conditions are very critical. The patient groups, the remote monitoring systems, mobile health and telehealth technology are the major and critically important options for the same. They help in

				building what is known as the 'clinic walls' that is important for both multidisciplinary care and multidisciplinary clinical research. Patient or participant engagement through the use of listservs, webinars, social media and also peer groups are critical for the multidisciplinary research and care. Clinical research management in the clinics and academic centers should be focusing upon only the multidisciplinary collaboration but also on the constraint factors like the clinical throughput and productivity, space and time barriers. Moreover, it is important the enrollment procedure has to be standardized so as to save the patient's time and digital technology can be used for this as well. The dedicated web portals, the newsletters should be

				used for the research communications purposes.
20. How psychologists help solve real-world problems in multidisciplinary research teams	Proctor & Vu 2019	Systematic review and thematic analysis	10 articles	According to the researchers of the study, the psychologists are trained with diverse researching skills and disciplinary methodologies that comes really useful in clinical research. That is why, it is important that the psychologists should be a part of the multidisciplinary clinical research team. According to the researchers of the study, the skill sets of psychologists allows them to communicate and team up with thirty other disciplines in which medicine, electrophysiologist. pharmacology, public health, sociology, statistics, political science, psychiatry, pediatrics, neurology is included. Effective financial management, extrinsic motivation and performance management, research

				communications and coordination as well stakeholder management is required and the presence of the psychologist helps out the process in a great extent, given their knowledge and skills. Conflicts may arise from dissemination and incoordination problems and the presence of the psychologists have been found to develop the intrinsic motivation of the team and solve the internal plus external problems in effective manner. The pragmatic and the real-world applications of the research findings can be a serious problem and the psychologists are the professionals who can solve and analyze these constraints. They, as for a matter of fact can sort out the real world, social and cultural problems through the modification of the conclusions, results and even methodology and findings in an

				effective manner. Better workplace management and goals achievement is possible with having a psychologist in the multidisciplinary team.

Data analysis

The codes were applied to main areas of the research findings and the themes were developed based on the same. Only after proper reviewing of the initial themes, the final themes were established.

Findings and Discussion

There are four themes that were found as a result of the data analysis. Each theme covers a shared area of perspectives and aspects which gives insight to research problems and solutions to the same. All the themes focus to understand the different factors that affect and improve the quality of the clinical research.

1. The need for multidisciplinary team in clinical research – The multidisciplinary collaboration between the academic, translational, experimental and the clinical scientists has been found to be extremely important for the improvement of the clinical research quality. The allied health care professionals such as the physiotherapists, podiatrists, orthotists, auxiliary workers, psychologists have a great role to play and they should be collaborating well with the nurses, physicians and surgeons in order to improve upon the quality of the clinical research being conducted (Paisley et al., 2012). The role of the educators, study coordinators, research managers are also very critical and multidisciplinary team will be help in diverse research thinking, better problem solving and diversified research teaching that are all very much pivotal (Diaz, 2020). The fact that in the modern-day patient care frameworks, multidisciplinary care is required and that is actually the multidisciplinary nature of the clinical research which actually informs the multidisciplinary team

practices in a proper manner (Levy et al., 2020). Moreover, the role of the bioscience experts like microbiologists, physiologists and social science experts like psychologists and sociologists are important as with their subject matter expertise, methods and methodology knowledge – they can surely contribute a lot to different stages of the clinical research. That is why, the preclinical, animal experimental studies are critical to be conducted before the clinical trials. And this is where, the basic life science researchers, biomedical scientists and the academic scientists surely have a very great part to play (Proctor & Vu, 2019). The multidisciplinary collaboration between the clinicians, the allied health experts, general practitioners, social workers, disease experts, community workers, administrators and managers are often vital for the overall undertaking of the clinical research over the years and also to improve the delivery outcomes. The importance of the translational researches is increasing day by day and they should be undertaken before, simultaneously or after the clinical trials in order to understand the effectiveness of the clinical research at a molecular level to system level to the population level (Seals, 2013). That is why, bioscience and biomedical researchers from multiple basic and applied life sciences fields should be collaborating well in order to undertake the pre-clinical, clinical and post clinical translational researches properly. Diversity in the multidisciplinary team should be high enough or rather appropriate enough to support the needs and the outcomes of the research. The benefits of having a microbiologist in a multidisciplinary research team are many that ranges from better understanding areas like infection control to infection prevention and epidemiological system's thinking (Paisley et al., 2012). The benefits of having physiologists in the clinical research team are many such as they can work in different stages of research. The physiologists also have extensive knowledge about different levels of translation ranging from molecular physiology, cell physiology, systems physiology, organism physiology to population physiology and public health (Seals, 2013). And this helps in gaining of tremendous insight about the strengths and weakness of the clinical research. The presence of a psychologist is

also very useful in many ways as they help in developing intrinsic motivation of the team and also give better ideas to counter and the address the real-world problems through the modified clinical research methodologies and outcomes (Proctor & Vu, 2019). In other words, the multidisciplinary clinical research teams that consist of sociologists and psychologists are in better position to address and solve the modern-day sociocultural problems associated with health conditions such as stigmatization, communication and language barriers, gender issues, social difference and injustice (Proctor & Vu, 2019). The multidisciplinary collaboration is important to address the issues at systemic, population and the local levels and also to prevent any kind of risks (Cowie et al., 2017). The collaboration between the research program directors, project managers and the mentoring faculties is also critical to help teach, train the new researchers and they are also responsible for the quality control of the clinical research that is to be understood as well. The data analysts, statisticians and information technology experts are also important support members of the clinical research team. At times such as in the cases of terminal disease and gerontological research - the palliative care experts, the hospice experts and the pain specialists also become important members of the multidisciplinary clinical teams (Paganoni et al., 2017). Lastly, the most important fact due to which multidisciplinary teams in clinical research are required is due to lack of research knowledge and skills in most of the physicians, surgeons and nurses. And that is why, this gap should be closed well by the recruitment of the academic researchers, bioscience and biomedical researchers, academic scientists and translational scientists (Boselie et al., 2021). The trialists, study coordinators and managers are important members of the multidisciplinary team as well. Also, multidisciplinary collaboration has benefits like clinical research risk management, cost reduction as well as achievement of effective results, safer dissemination and safer care delivery approaches (Chung et al., 2017). The multidisciplinary collaboration between the professionals of biomedical, translational,

implementation sciences is very much critical so as to improve the clinical research quality in the country (Hoffmann & Kettelhack, 2012).

2. Importance of hiring, retention and training of diverse research workforce – There is a great importance of hiring, retaining and engaging the right clinical research staffs in an effective manner which is imperative and binding. The retention of the members of the multidisciplinary clinical research team is affected by a number of factors like professional conflicts with management and team, cultural differences and social discrimination, lack of unified decision making and workplace compassion, lack of supervision and negative team culture (Abshire, et al., 2017). As different stages of the clinical trials take years and decades to get completed, the level of stress and anxiety is found to rise to a great extent in the clinical and academic scientists which can create serious types of problems like disruption of work life balance, workplace disruption and lack of motivation. This can then lead to the development of more risks within the multidisciplinary clinical research and that is why, it has to be managed and prevented at the earliest. Lack of positive attitude, lack of right skills and accountability as well as the disruptive behaviors presentation can all cause low work engagement in the multidisciplinary clinical research team members (Sener et al., 2019). And that is why employee engagement has to focused upon (Cowie et al., 2017). The intrinsic and extrinsic motivational needs should be addressed with the help of employee engagement, personnel and performance management, pay and appraisal strategies that is vital to note here. The behavioral management and the disciplinary feedback as well mentoring, training and skills development support should also be given to the multidisciplinary clinical research team employees as employee engagement strategies. Training, re-training and right resource allocation practices in the research centers is highly critical to improve upon the outcomes of the health, medical and the surgical researches. As a very high level of coordination, collaboration is required for the team activities and scientific research undertaking – it is important to develop a positive, safe and supportive team culture

(Chung et al., 2017). For conflict resolution - a culturally competent practice of the scientists and clinicians should be mandated with the help of standardized operating protocols and procedures. All these strategies are highly critical for the retention of the staffs and the employees (Abshire et al., 2017). As the staffs of the multidisciplinary teams are from different sociocultural backgrounds and academic backgrounds, the conflicts and feelings of discrimination can affect the performance of the scientists and the clinical researchers. And that is why, the employee engagement and the retention strategies are so very important. Effective incentivization, financial and non-financial awards, rewards and recognition should be given to scientists and staffs of the research team who have excelled in their work (Boselie et al., 2021). These workforce management, retention and regulation strategies are important for the development of feelings of engagement and commitment in the staffs of the clinical research teams. Continuous learning, educational and professional development opportunities are critical to develop engagement in the employees and close the knowledge and skills gaps (Seals, 2013). Seminars, workshops, database management and access, mentoring and supervision, teaching support, peer review and feedback as well as assessment taking are vital for learning, training and development of the researchers (Perkmann, 2013). This will not only improve the quality of the research but also help in their retaining over a long period of time and add to their job satisfaction. The postgraduate students and the residents who are pursuing their masters or doctorates should be made research ready with help of research education and research training that is critically important (Worly, 2017). As multidisciplinary research team formation is critical to the success of the clinical research, the right hiring and resource allocation practices are very important as well (Sener et al., 2019). Moreover, for diversity management, work life balance and stress management of the staffs - the organization should be communicating continuously and at regular intervals with the staffs and other stakeholders. That is why, internal and external corporate communications is very important. This can be done more easily with the help of digital and

technological leadership that use website, newsletters, emails and innovative information disclosure techniques. Creativity and innovation are very important as in workforce management and leadership positions should be made available to help drive team and clinical research productivity (Chung et al., 2017). The research team members and the administrators should be trained in order to make them understand the business and fiscal side of clinical research (Farrelly et al., 2017). They should be trained so that they can use the technological tools like research software, scientific databases and marketing approval software to a better extent (Shetty et al., 2019). The hiring of the statisticians, data analysts is important so that they can support the clinical research team with the data analysis and error free data reporting. The students and the residents should be trained on the research methods and methodologies at postgraduate levels so that they can be competent researchers in the future and that is why, research dissemination and research teaching is very important as well (Worly, 2017). Job designing, best hiring and retention practices has been found to be most effective for the maintenance of job satisfaction and to create positive experiences in the clinical research staffs (Boselie et al., 2021). The human resource managers and the administration of the organization is solely responsible for the fulfillment of these above-mentioned roles and functions (Mohan et al., 2017). A broadened roles of the human resource department include development of journal clubs, job rotation and shadowing, research rotations and academic classrooms for the training and educational purposes. Research job allocation to the nurses, physician assistants and nutritionists is also very important for clinical research as they can assist the clinical and biomedical scientists in their research works (Farrelly et al., 2017). Effective resource and capacity building activities are important for the improvement of the quality of the clinical research. The training of the academic and the biomedical scientists on the electronic health records is vital to store, access, secure and save data safely. Thus, the technological training is also a very integral part of the employee training and onboarding (Cowie et al., 2017). As patient and population data is very sensitive, strong practice

policies and data usage regulations are enforced by the government to ensure public health and civil safety. That is why, each and every researcher of the clinical research team should be trained and retrained on portal and website use, data upload and sharing protocols (Worly, 2017). This is extremely important as for learning and development as well as proper working of the multidisciplinary clinical research staffs.

3. Strengthening of government support and funding policies – funding is a major and a very critical problem in the countries such as India (Righetti, 2015). Allowing grants and funding for the right research at the right time is a serious problem in the country. And that is why, only a few research centers and medical colleges actually take part in the clinical research (Shetty, 2019). And to be noted, that due to this barrier, the contribution of India to global clinical research is extremely low and the right steps are needed to be taken. The poor socioeconomic status, lack of research culture and awareness, distorted social determinants of health prevents many clinicians and academic professionals from taking up full time research positions and this is also chiefly due to the uncertainty associated with long term research works (Abshire, et al., 2017). The increasing levels of regulatory compliances have only increased the stress amongst the researchers and prevented them from contributing to the clinical research to their full potential. That is why, the government support at the federal level, state and local levels is required to a great extent and strategic budgeting, financial management, regulatory frameworks and compliance with practice policies are required to be developed by the government and the policymakers (Abshire, et al., 2017). The policies regarding the clinical practice to research time ratios for the residents and the physicians or clinical scientists should be developed and effective incentivization for the development of research excellence is also very important from the side of government (Sener et al., 2019). The funding and grant support from the government should be coupled with good incentivization structures and policies regarding documentation practices so as to develop accountability in the staffs from the clinical research centers

(Abshire, et al., 2017). Along with good budget allocation practices, good resource planning and allocation practices should also be undertaken by the public research organizations and the organizations in public-private partnerships. The funding, financial management, human resource and workforce management strategies and best practices should be supported by both organizational and government policies (Worly, 2017). National seminars, face to face meetings, video conferences and virtual teaching strategies plus workshops should be used in order to develop the skills and the interest in the clinical researchers to take up a full-time research career (Mohan et al., 2017). The funding strategies by the government and the policies should be able to motivate the clinicians and academic scientists to take up clinical research, which is the utmost need of the country, given the increased prevalence of the chronic, acute, infectious and noninfectious disease conditions. At times, due to the cultural and social differences and also due to the racial tensions, the research undertaken lacks the diversity in terms of participants. And that is why, it is important that policies regarding cultural competence and diversity management is effectively formulated by the government. Communications in form of advertisements, diversity inclusion and boardroom discussions should be mandated and enforced by the laws of the government to include more diverse population in research (Oh et al., 2015). The policies regarding care coordination, research quality management and reporting, contact management and educational curriculums should be planned and formulated properly after collecting national-wide and other forms of public and organizational data (Perkmann, 2013). The government should have strong regulatory controls on the price and costs of research products and research respectively and ethical compliances should be mandated for all clinical research getting conducted in public, private and public-private institutions. All these standardized policies and procedures are highly cardinal in order to improve the quality of the clinical research and also the safety of the human subjects involved in the same.

4. Fortification of Academic-industry relationships – as funding is a major problem in the country, most of the clinical researchers are funded by local and multinational pharmaceutical organizations. That is why, most of the clinical research conducted in the country is industrial and only a very few of them are academic. This is due to lack of research funding and infrastructure in the academic institutions like the medical colleges (Righetti, 2015). That is why, the effective stakeholder management, marketing communications and policy development are required for the development of the academia and industry relationships (Ramsey et al., 2017). The large-scale production and manufacturing companies have the infrastructure and the labor to produce the products such as new drugs and instruments, but they need to collaborate well with the academic scientists and the clinical scientists in order to conduct the actual clinical trial (Shetty et al., 2019). The teaching, researching opportunities, publishing and independent patenting opportunities should be provided to the scientists and clinicians by industry so that they take up clinical research as a full-time career. The large multinationals have the financial reservoir and capital leadership to support the independent academic researchers as well and that is why, more collaboration between the academia and industry is important. Thus, the right hiring practices, job drives, and advertisement activities are needed to a great extent, in order to facilitate and realize the potential academic-industry relationships (Mohan et al., 2017). The digital and technology leadership for fast and safe database management, data storage and security, data sharing and business communications is critical and that is why, the big companies are in the best place to support the clinicians and scientists with clinical research project management and secure data management. Funding, training and educational support can be given to these academic and clinical scientist professionals by the pharmaceutical companies to develop their skills and knowledge, that will improve the outcomes of the clinical research and business outcomes of the company too. The webinars, social media and the listservs can be used for the stakeholder communications and inclusion of more participants in the industry-academia collaborated research

(Paganoni et al., 2017). The management and administrative infrastructure of the industries should be flexible and supportive that will help the academic experts to undertake their clinical research without any risks or other form of stresses. The funding, grant and leadership support can also be given by the industry so that the clinical research is progressed in the country without many problems (Ramsey et al., 2017). Also, the entrepreneurial opportunities and salary support for undertaking of long-term research can be better given by the industries due to their large capital reserves and this can help the academic scientists to continue their works for a long period of time (Perkmann, 2013). This in a way, also reduces the dependency of the academic research centers on the government grants. The connectivity between the researchers can be increased with the technology and digital leadership that will help in seamless data sharing and increased research productivity. Commercialization of the academic experts through the providing of consulting, teaching and publication opportunities is very much critical and that is why, industries can support them effectively (Perkmann, 2013). Moreover, the risk management and the quality assurance frameworks are already present in most of the big and multinational biomedical instrumentation companies and pharmaceutical companies (Ramsey et al., 2017). And these frameworks can be used effectively to draw compliance of the research workers with federal level and organization level research policies plus clinical trial practice policies. As the industries generally have the corporate communications and public relations departments, they can use it effectively with the government agencies to disclose the research findings effectively and safety (Shetty et al., 2019).

The multidisciplinary research has been often found to increase the spectrum and improve the applications of the clinical research. Multidisciplinary research has also been reported to have serious advantages over individual or single discipline researches in the areas of complex research problem solving and shared decision making that helps to solve the real-world public health issues in much better manner (Diaz, 2020). The presence of psychologist and the sociologist in the multidisciplinary teams would help the better solving

of the real-world problems and will help addressing of barriers to the external validity of the clinical research (Proctor & Vu, 2019). The holistic understanding of physical, mental and social health determinants is better possible with the multidisciplinary clinical research teams, and this leads to all round research problem management and effective risk prevention as well. There have been many evidence in favor of the multidisciplinary clinical research in terms of real-world problem solving and many researches have highlighted the problems with multidisciplinary clinical research teams like conflicts and workplace disruption that has been managed with the help of effective strategies. Better risk stratification and risk mitigation is possible with the multidisciplinary clinical research teams and a much broader research vision and mission can be utilized with the multi-disciplinary research teams due to diversity of skills and knowledge in the team, as indicated from the finding of the research. Intercultural communication and effective professional communication, peer support, supervision and safety culture are often seen as important implications of the multidisciplinary clinical research team management (Chung et al., 2017). There are incidences of high stress, anxiety, health safety issues that are also reported in multidisciplinary clinical research teams due to the increasing number of conflicts between the members (Jeanguenat & Dror 2018). These can be solved with the development of strong human resource management and workplace health safety policies by the administration.

The social culture of the country is not also supportive of the clinical research because of the fact that the clinical trials and similar research takes years to complete, even decades. The research awareness is typically missing from the framework of the country, and this is seriously a very major barrier to the clinical research (Kureethara & Antony, 2019). The lack of the economic support and lack of job security in the clinical research field are the major issues that prevents potential clinical research experts from pursuing a full-time clinical research career in the country of India. The lack of proper governmental support and robust legal policies so as to improve the clinical research quality in the country is missing and these are the various areas that are to emphasize upon for change as well. The change management with respect to the clinical

research in India needs a lot of focus in the areas of human resource planning and management for development and regulation of effective workforce in clinical research frameworks (Madhan, Gunasekaran & Arunachalam 2018).

The different types of complex issues pertaining to lack of multidisciplinary research team formations in clinical research, diversity management and research risk management has all been related to insufficient academic and industry collaboration and ineffective human resource management. The clinicians get most chances to participate in the clinical research even if they do not have the required research education like the other biomedical research professionals. This cause quality issues. The lack of proper involvement of the psychologists, microbiologists, biochemists, biotechnologists, physiologists and other biosciences experts in the medical, surgical, pharmaceutical, and lifestyle medicine research cause the risks to develop (Atun-Einy & Ben-Sasson, 2018). The multidisciplinary associations provide various perspectives, shared body of scientific knowledge, multifaceted thinking and multiple arrays of risk control, diverse research methods and methodologies that overall have a great beneficial effect on the clinical research. Multidisciplinary clinical research team can radically improve and optimize as well as maximize the outcomes and findings of the clinical research, but this collaboration and multidisciplinary interaction is majorly missing from the clinical scenario of the country (Paisley et al., 2012). The physicians are the only clinicians who by a huge margin, gets a highest opportunity to undertake the medical and surgical clinical research while in the real-world care scenarios, there are a lot of other professionals like the nurses and allied health care experts who take active part in the care management of patient. But unfortunately, they do not get enough opportunities to progress their education to master's or doctoral levels and to take part in the clinical research. This poses a major gap with respect to the clinical research quality and management in India. In the western countries, the educational system and educational administration is very flexible plus scientific that allows vast number of biomedical and bioscience researchers to take up a full-time research profession and this immensely helps the outcomes of the multidisciplinary clinical research (Meador, 2015). In both the industry and academic

clinical research framework of these advanced western countries like United States and United Kingdom, there are enough researching opportunities. This supportive framework is great missing in India which is comparatively much less research aware as compared to western countries. While there are very high opportunities for translational and multidisciplinary clinical research to be undertaken – the funding problems and clinical research management gaps does not simply make way for it. The research experts from the more academic disciplines of classical human biology have more molecular-level knowledge while the applied health science professionals like the medical and surgical staffs have more of the treatment and patient care knowledge (Fort et al., 2017). Thus, it can be clearly understood that the various types of the bioscience disciplines have different areas of subject matter and research area expertise, and the clinical research is incomplete without any of them (Shetty et al., 2019). That is why, the multidisciplinary research team formation is very important. The very low clinical research quality in the country is attributed to the lack of these type of multidisciplinary clinical research team formation, lack of funding and workforce management as well as deficient research infrastructure management (Levy et al., 2020). The lack of multidisciplinary clinical research collaboration also deteriorates the research teaching quality that affects skill development of the future clinical research workforce (Worly, 2017). There are thus many gaps in the clinical research scenario and health care system of India that needs to be closed to improve the research quality in clinical framework of India. Most of the time of the post graduate clinician professionals are spent in teaching and clinical responsibilities, hence they do not get enough time to undertake clinical research. This is a major time related barrier to clinical research in the country. According to some participants, they needed to give time to their families as well that prevented them to contribute their life to research. As for the general barriers, it was found that the international journal editors politicized the works of clinical researchers based in India because of quality issues and social differences. The lack of technological training and informational technology innovation in the research centers leads to the development of complex delays in trail stage progression and publication processes (Bleich, 2021). The publication of the clinical research in international

journal is costly and also discriminated as per the perspectives of the Indian medical science researchers which is a serious problem (Rooban, Madan & Poorni, 2014). These are the reasons why the appropriate form of technology incorporation, technology training and research innovation is required that is vital to be done. Other than these, according to the researchers of the study, lack of computer and secretarial assistance leads to major gaps in the clinic research work framework (Lin & Kishore, 2021). The problems with grant writing as well as lack of supportive teaching and guiding atmosphere in medical colleges - are major barriers to clinical research in the country. That is why governmental support in educational curriculum development and industrial collaboration for infrastructure and technological development is very much invaluable to the clinical research, done in the country. Both government and not-for profit organizational support are needed for the funding process. The disease support groups, patient advocate groups as well as the multinational and big corporations are major sources of funding for the clinical trials. That is why external communications and stakeholder management as well as financial management become very important for the maintenance, regulation and development of the multidisciplinary clinical research teams. The technology leadership is also important for data management and marketing approval as well public disclosure purpose. The clinical research management should be technology ready (Shetty et al., 2019).

Research teaching and training should be mandated and delivered with the help of the offline and online strategies. A number of trainings such as simulation training, technological training, research skills development, behavioral training, operational training, hands-on instrument training and classroom training are required to be given to the clinical researchers and residents plus scholars (Mohan et al., 2017). And this is where, the human resource management (HRM) role in learning and professional development of research teams comes to play. The role of the human resource management is to align the organization's financial outcome and strategic needs with the human resource factors and their performance in the organization. That is why, in the clinical research framework, the performance and personnel management of the professionals becomes extremely vital (Boselie et al., 2021). At first, it is to be noted that due to long term nature of the

clinical research work and in scenarios like the pandemic or other civil and international crisis, when the burden of the laboratory work increases, the stress is bound to increase. The increased level of anxiety in the clinical researchers can lead to burnout and detachment from the work and absenteeism that can affect the overall performance of the individual plus the multidisciplinary clinical research outcomes and also of the clinical trial processes (Arpentieva et al., 2020). As clinical trials are regulated by strict regulatory laws and protocols, it is very much important that the anxiety and stress levels occurring due to this in the clinical researchers is measured and assessed properly. All these areas can serve as alarms and indicators of burnout and stress in the workers that can lead to the development of workplace crisis and disruption. Managing the early signs of distress in the clinical researchers will not only control the risk of disruption but also mitigate the crisis at its earliest. That is why, one of the most important functions of the human resource management is to develop employee engagement. The engagement strategies used by the human resource management can be rewards and recognitions for research excellence, incentivization, appraisal and good pay structures, appreciation and acknowledgement of the hard work put in by the clinical researchers and by the team. The newsletters and emails can be used to celebrate the life events of the staffs such as birthdays and professional anniversaries. These are powerful enough motivational tools that can strongly contribute to employee engagement and positive experience of the employees (Verčič & Vokić, 2017). The internal communications are very much a core part of the employee relations that is to be done by the human resource management as well. The decision and the information passed from the administration should be communicated regularly to the clinical researchers and this is where, the intranet, office bulletin as well as direct meeting and briefing strategies can be used by the human resource management as the communication mediums. The external stakeholders to the company like the government, government agencies, federal policy makers, the buyers and the distributors is equally important as the internal stakeholders of the company, and this applies for the clinical research and related new product development as well. That is why, it is also the very duty of the human resource department to schedule the contacts for the researchers and train the clinical researchers on

usage of marketing approval applications and clinical trial software (Abshire, et al., 2017). As it has been found out, the technology skills of the Indian researchers are very low, it is important for the human resource department to provide effective online and offline technological and research training to the clinical researchers of the multidisciplinary team (Mohan et al., 2017). The mentors should be assigned to each of the clinical researchers, especially the new joiners so as to build hands-on skills and confidence, that is required for highly critical day to day jobs of clinical trials and research. That is why, the implication for the human resource management is not only for off-the-job training but also for on-the job training of the clinical researchers. The human resource department (HRD) can communicate and network with the industries and government agencies for the setting up of workshops, seminars, video conferences, webinars, virtual and classroom teaching sessions. And all these learning and development activities will contribute to the continuous professional development (CPD) of the clinical researchers. These are vital human resource management strategies to be used for employee engagement and for closing the skills and knowledge gaps in the multidisciplinary clinical research team, according to the researchers of these article above (Holmes et al. 2020). Other than work life disbalance, the professional, social and the cultural differences between the members of the multidisciplinary clinical research team can also lead to the development of conflicts and workplace stress resulting from the same. This can lead to problems such as decreased productivity, delayed pace of actual research conducted, increased operational costs and increased overall research costs resulting in losses. Moreover, the health safety issues of the staffs can also rise that is an ethical problem as well. That is why, retention strategies and workforce management strategies used by the human resource managers and project managers should focus on what is known as the diversity management (Bakir, 2017). Building up a culturally competent research culture inside the organization, setting up standard operating procedures for step-by-step lab work, drawing of clinical trial protocols compliance and disciplinary compliance within the workplace are the various steps that are to be taken by the human resource management, according to findings. The postgraduate health care students and allied health students should be given research teaching

and they should be practically trained on the methods and methodologies used in the research. It has also been found that the peer –feedback as well as the time management skills should be taught to the residents and clinical researchers as they have both practice as well as the research duties (Holmes et al. 2020). These strategies by the human resource managers will not only help in the learning and development of the staffs but also help in maintaining the safety culture, thus resulting in retention and effective stress management. Socialization should be allowed at workplace and team works should be promoted that will encourage the research staffs to respect each other professionally and personally, within the multidisciplinary research team (Boselie et al., 2021). Another very important area to be addressed is the fact that in countries like India, the researchers not only do not have the effective technological skills, but they lack the documentation skills as well that leads to life threatening and other ethical problems in the clinical research. That is why, the disciplinary compliance, behavioral training and management with respect to the acceptable workplace behavior, documentation of the research tasks, project information, patient information and critical events are required. And that is why, this training is also very important to reduce and eliminate all type of safety issues that can arise in the multidisciplinary clinical research scenario. Health safety of not only the clinical research staffs but also of the patients who are the participants in the study is very critical to be maintained with regulatory and ethical requirement policies. That is along with behavioral and technological training, health safety training and also cultural training -should be given to the clinical research team members (Bardhan, Chen & Karahanna 2020). And these above-mentioned human resource strategies will help in the maintenance of the multidisciplinary clinical research teams in effective manner.

In surgical and medical management, the multidisciplinary care is highly important and so it is for diabetes care, that is why, the multidisciplinary research team is required. Training and involving the allied health workers, the social workers and community practitioners who are very important alongside physicians, nurses and auxiliary workers in pre-operative and post-operative care – is vital. According to some findings, the members who are to be part of the multidisciplinary team should also be trained and involved in clinical

research (Cuevas et al., 2012). The evidence-based practice and research informed practice is missing in India to a great degree and that is why, more high-quality clinical research are required. Best practices in hiring, recruitment and capacity building are required in order to build the right workforce and to form the multidisciplinary research teams.

The benefits of the multidisciplinary teams have been found to be many such as better time management, better problem solving, multi-faceted decision making, reduced costs and better clinical research outcomes (Wynstra, Suurmond, & Nullmeier, 2019). Individual researches conducted discipline wise results in increased research costs on the overall and that is why, collaborative clinical researches with multidisciplinary teams should be undertaken. The implementation sciences are critical to the application of the clinical research in public health scenario and that is why, applied biomedical professionals and social scientists should be an important part of the multidisciplinary clinical research team (Grossman, 2016). The translational sciences play a major role in the stage wise understanding of the clinical research development from molecular to cellular level to systems and population level. And that is why, the academic scientists and the translational scientists should be a part of clinical research (Djurisic et al., 2017). They can contribute to the progression of the research in a safe and purposeful manner. The safety of the patients during the research and the safety of the population after the clinical research, should be ensured beforehand. And that is why, the clinical testing of the medicines, vaccines, interventions at the molecular level and tissue level should be done (Cleary et al., 2018). That is why, physiologists and other molecular biologists should be involved in the preclinical studies and even clinical trials in order to ensure the safety of the research products being developed and also of the patients (Seals, 2013). The infections and the spread of the infectious diseases are critical to be controlled and the resistance problems are increasing in the hospitals and nursing homes. That is why, the microbiologists and the academic scientists from the field of pathology should be involved in the clinical research as well which is vital. While applying the clinical research recommendations and the findings to the real-world scenario, there can be interruptions by a number of factors such as the sociocultural

and perceptual problems, economic and national issues. And that is why, the inclusion of the psychologists and the sociologists in the clinical research is important to solve these issues and problems, in a very pragmatic and proper manner (McAndrew,et al., 2019). Given the skill set and knowledge base of the psychologists who understand the human factors and human psychology very well, they can collaborate with several professions and clinical researchers as well. They can help motivate the team and understand the reason of internal conflicts and they can surely help out the situation, in a positive manner. The importance of the allied health workers has increased over the years and their role has become almost as important as the physicians and the nurses and that is why, their inclusion in clinical research is important. Again, continuous professional development opportunities and higher education opportunities is to be given. In research with special research requirements, even the hospice experts and the palliative specialists should be recruited, and the human resource management should have a broader scope of practice in hiring, recruitment and regulatory activities. Job design, career development activities, mentoring and educational support, key role activities planning, compensation, orientation, promotion, training and development are important personnel management activities that is to be done effectively (Wiśniewska, 2020). Equity and feelings of team spirit should be maintained and encouraged as well. As clinical research is a long-term process and a lot of quality control is needed, hiring the project managers and the quality managers can be important.

Funding is a real problem in the country and grants for the clinical research is not available most of the times that prevents the professionals from entering the research field as a full-time career that is important to understand. The economic standing of India in the global front is still poor and that is why, most of the economic flow are directed to other clinical care departments other than research. But health care is a very serious necessity, and the clinical research is the way to improve the quality of the clinical care being provided in the hospitals and other health care centers. Even community care benefits very much from the clinical research but the research culture, infrastructure is missing from the country to a great extent. Informed practice and best practice policy development should be following clinical research and novel drug

development (Oh et al., 2015). The long-time taking nature of the clinical research often requires complex project management strategies and this demands high funding and grants to be provided on a regular basis. The lack of funding can lead to the delays and unnecessary breaks in the research process, and this can seriously affect the pace and safety of the participants and of the population. Therefore, the industrial support for undertaking of the clinical research is highly important as well. The big multinational organizations such as pharmaceutical companies and biomedical instrumentation companies actually funds most of the clinical research in India but mostly for the industrial reasons. The government needs to collaborate with the industries and formulate standardized regulatory compliances so that academia and the industries can work together in more effective and stable clinical research (Gingles & Gewertz, 2019). The needs of the industrial research can differ from the health care research needs of the country and this difference is to be understood very carefully. That is why, the clinical research funding needs to chaperon and channeled towards the actual public health and country wide population needs (Ramsey et al., 2017). This regulatory control is required from the side of the national government so as to have the best of outcomes from the industry level clinical research (Shetty et al., 2019). Capital budgeting, strategic financial management, resource and capacity planning, right hiring and retention strategies are very important for this purpose. The right workplace, documentation and research practice related policies should be mandated by the government and more public infrastructures should be made available to the researchers, given the needs of the public health research. The use of electronic health records and technological training for the right use of databases and for effective research data management – should be supported by the government and the non-governmental organizations as well (Oh et al., 2015). The disease support groups, and the patient advocacy groups also have an important role to play and stakeholder management by the research organization is very much cardinal as well. Regular and proper communications as in external and internal communication systems should be developed and maintained so that there is no disruption in the clinical research process.

The industries already have the needed infrastructure and capital reserve for the research to be undertaken in a very effective manner and that is why, academic scientists and the academic research teams should be supported by management of the industries, for better results (Hall et al., 2018). The results will not only better the public health condition of the country but also the help in the profit-making ventures of the company while doing supporting the public health. Thus, for-profit organizations can impact the clinical research and its undertaking in a major way as because the government do not have enough funds to support the public health and clinical research, in India (Mårtensson et al. 2016). More philanthropic and corporate social responsibility actions is required to support the clinical research and public health research needs in the country. The publications are very costly in the country and many researchers do not afford to pay for the same as well and this is where, the industrial support for publishing, consulting and entrepreneurial opportunities is required (Perkmann, 2013). The independent researchers as well as the group researchers should be supported with the industrial funds and the industrial management support plus good incentive structures to improve upon the performance of the workforce. The quality managers and the project management professionals are generally present in manufacturing industries who have both the domain expertise and the experience (Roddam et al., 2019). They can be used in the clinical trial and clinical research management as well. The in-house workforce and the existing leadership capital of the company can be used for the general managerial work, but the specialist clinical research managers and human resource specialists can be hired from outside (if not present in the company) in order to manage the clinical trials properly (Ramsey et al., 2017). The pharmaceutical companies and biotechnology organizations have the right infrastructures for the clinical research involving drug development and testing. The clinical research in the field of medicine, surgery and allied health can be done in hospitals, both private and public but the government support is very much required.

The clinicians and the physicians in the health care framework are always burdened with the clinical work and they do not get enough time for the research. This is because physician is to patient's ratio is very

low in the country and they need to see much patients every day that actually takes away most the time required for or allocated for research work. These are the areas that needs to be managed effectively and clinical work is to research time ratios must be standardized with policies properly. The enough assistance should be given to the physicians and nurses (Levy et al., 2020). Moreover, the delegation of non-clinical works to the auxiliary staffs and training them further to manage the preliminary clinical tasks can be very helpful a strategy as because this will free the physicians and the nurse of complex paper works and not so serious clinical tasks (Paganoni et al., 2017). This will also then give them the time required for the research work and for continuing higher education. Resource management, technology management, human workforce management and time management are thus the most critical areas that are to be protocolized with the standardized operating procedures (Sener et al., 2019). Again, it can be understood very clearly, that training management is one of the core areas of personnel and clinical research management. The price controls can also be put by the government on the publication businesses which will allow more clinical research works by group and individual researchers to be published in an affordable manner. The price of publication in the international journals is too high for the clinical researchers based in India and that is why, there is a need for more Indian Journal publication companies which indicates that the government needs to invest in these sectors as well (Dhammi, 2018). The technological integration in the hospitals such as the electronic health records, electronic medical records and other advanced automations will help and relieve the physicians and the other clinicians of the burdensome official file work, and they will have time to take part in the higher education and clinical research. Along with the funding, human resource management, workplace and workforce management, it is to be noted that policy making, and technology leadership is also extremely important in multidisciplinary clinical research (Li & Wang, 2018). The managerial and the administrative support, the academic-industry relationships along with the right hiring, regulation and retention strategies used in clinical research – are very much important to be applied in right context (Jasny

et al., 2017). The public health scenario in India is getting worse due to the lack of clinical research and that is why, it is needed so much.

Conclusion

Thus, it can be said that there are a number of complex factors affecting condition of the clinical research. Lack of the funding and ineffective financial management is leading to delays, stoppages and even non-initiation of the important clinical research in the country. The government needs to work very closely with the research organizations and also conduct the surveys to understand the needs of the clinical research in the country. It is important that the budging and the channeling of the monetary resources is done in the most effective of manner so as to support the long-term clinical research in an effective manner. The cost of publication in the international journals, the inclusion of diverse participants in the clinical research team is a matter of serious issue because of the good amount of funding and monetary support that is required. And the economic condition of the country does not allow it most of the times. That is why, proper level of the financial, strategic and marketing planning and communications is required in order to involve the right stakeholders in the clinical research. The stakeholder management has been found to be as important as the workforce management and workplace management and there are other factors that has to be managed and prevented effectively as well. The multidisciplinary clinical research teams have been found to be very important in terms of better time management, task management plus better problem solving and also for the fact that the collaborative research save time and money as compared to the individual discipline wise research. The formation of the multidisciplinary clinical research teams can be difficult and that is why, it is vital that the innovative hiring approaches are used by the human resource managers. Capacity building planning, recruitment and resource allocation are the major areas of the staffing process that is to be followed and done carefully in the clinical research settings. Based on the needs of the research and the multidisciplinary care that will be given afterwards based on the findings of the research, the

multidisciplinary research teams will be formed and just like the physicians and the nurses, the inclusion of the allied health workers are also very important. The fact that the allied health workers are core part of the multidisciplinary care teams on most occasions, they should be trained and educated to become a part of the multidisciplinary clinical research as well. The psychologists have a range of human management and psychological care skills as well as the research skills and they can help the functioning of the multidisciplinary clinical research teams. The psychologists and the sociologists help in the better dissection of the real-world problems from the community and the social perspectives, and these factors are very responsible for the determination of the external validity of the clinical research that is critical to understand. Research finding no matter how powerful or novel they are, it will not be accepted by the people of the country, if it is not aligned with their values and systems and that is why, the inclusion of psychology and social experts helps to solve these issues. As the multidisciplinary teams have a number of members and the staffs coming from the different social, cultural and professional backgrounds – there can be a number of conflicts and confusion in the team due to knowledge and communication gaps. In order to manage these problems, diversity management as well as standardization of workplace behavior policies is important and these are the responsibilities of the human resource management. The training and re-training of the team staffs in order to develop unity and collective team efforts is necessarily important. The research training, technological training, the classroom behavioral training, simulation training, on job training, mentoring and the supervision support are all very much critical for the development of required research and self-management skills in the clinical researchers. As clinical research is a long-term process, it is important that the staffs are trained and upskilled properly so that they have a positive experience while working at the clinical research workplace. As the job security and the stress levels of conducting the clinical research is very high and moreover, as the research culture is not present in the country, it makes it even more difficult. The distorted social determinants of health such as poor economy, lack of health literacy, social values, healthcare accessibility and health care affordability issues affect the length to which the scientists and the

clinicians perceive the security of their full-time research career in India. Moreover, the high regulatory and procedural compliances to be adhered with daily, also affects the stress and anxiety levels of the clinical researchers. The excessive burden of the work has been found to affect the work life balance of the clinical researchers of the multidisciplinary team and that is why, task allocation more equally and strategically between the members of diverse clinical research team is highly critical. The stress management and the workforce retention strategies are highly critical to be undertaken by the organizational administration and human resource management. The internal communications using several ways that uses technology and also the traditional ways of communication like display boards, the meetings and briefing sessions have to be used in order to render the right results possible. A more informed clinical research staff can contribute better to the clinical research for a long period of time but continuous communication, mentoring and career development support should be given. This led to better amount of the workplace engagement and more organizational productivity, allowing the clinical research to be undertaken in an uninterrupted manner. Moreover, the rewards and the recognitions, the prestigious awards for the demonstration of research excellence – is important to be provided. This will help in the development of motivation in the clinical researchers and the psychological and esteem need of the researchers will also be addressed in a more effective manner. Along with this, the other retention and employee engagement strategies will be focused on areas like job designing, time management strategies, pay and appraisals plus incentivization. The incentivization from the side of the government and from the side of the organizations is critical to the retention of the clinical researchers over a long period of time. Directing, training and development, compensation and giving the job promotions at the right time are very critical for the personnel management that must be done very closely and strategically by the human resource in clinical research scenario. The health, safety issues are common in the clinical research frameworks and that is why, the necessary training and robust policy making is very much critical to maintain the safety of the patients and the researchers. The safety culture and the research culture should be incorporated in the academic institutions as well as in the

private plus industrial frameworks. And the team effort should be mandated to maintain safety, respect and tolerance at the workplace that is important to understand. The cultural competence should be developed in the clinical research staffs that will help them communicate with each other in better way and help in the development of the cultural safety while working with the patients and participants from culturally diverse backgrounds. A lot of training and development is required for the development, upskilling and retention of the clinical research workforce over a long period of time. But at the same time, providing them with educational and career development opportunities can be equally important and also very much vital. The seminars, workshops, teaching sessions and the virtual classrooms should be set up and provided to the clinical researchers that will help them undergo continuous professional development. The video conferences can be equally important as well. The technology leadership has been found to be important as its role extends not only to internal communications and database management but also to training and development of the clinical research staffs.

As for a matter of fact, the pharmaceutical organizations and the biotechnology companies needs to be more responsible in the undertaking of the clinical research and the government needs to collaborate with the for-profit as well as non-profit organizations for the same. The marketing communications and the external communications should be done properly in order to procure the funds from different sources in an effective manner. The dissemination of the research information and the public disclosure of the research information needs to be safety done as well and that is why, training the staffs on the right use of tools and technological applications in a step wise manner is critical. And this is the reason why, there is a very high need of setting up the standardized operating procedures so that the official rules and regulations are followed by each and every researcher in the effective manner. The inclusion and the recruitment of the support staffs such as the information technology professionals, data analysts and the statisticians are critical because of the complex computing needs of quantitative clinical research. The hiring, recruitment and the workforce development practices is thus critical for the regulation and maintenance of the multidisciplinary clinical

research team over a long period of time. The implementation sciences, translational sciences as well as the basic life sciences are critical to clinical research as well as they study the problem at the very molecular level, cellular level and then at the population level. The formation of the multidisciplinary clinical research team has been found be effective and specialized human resource management is important for it – hence the hypothesis proved.

Implications

As the clinical research teams have training, diversity, learning and the recruitment needs, the specialist managers required for this job are the human resource managers. The human resource management (HRM) is in the best position to the plan, hire, on board, train and control the performance of the staffs and thus, the human resource managers who specializes in or have experience in clinical or at least in some type of research - should be hired. The human resource executives and the managers from another field can also be trained and educated by the public and private originations so that they can take up the more clinical research focused roles. Utilizing the workforce properly and allowing the existing members of the organizations to become part of the new clinical research projects undertaken is critical and this will result in saving of money and time as well. The human relations approach is very important to the clinical research management due to the intensive and human nature of the clinical research work. The bureaucratical approach to management using the official rules and regulations is also very useful. The administrative management approach can be useful in drawing the necessary governmental and the organizational compliances from the clinical research staffs and this is important to note here.

Another major implication is the fact that the electronic documentation practices by the clinical research members should be encouraged, trained and mandated. This is critical as technology-based software and hardware can store much more information than that of the traditional file documentation and paper entries. Alongside the human resource managers, the clinical research managers also have a major role to

play in the smooth undertaking of the clinical research and trials on a daily day to day basis. Together, they should also be responsible for the business communications and the marketing communications with the different departments, inside and outside the company. The new product development and health service development as a result of the clinical research should followed up with service, product sales and marketing strategies. It is to be understood that without the capital inflow and the profit, the clinical research cannot thrive in today's competitive market. And that is why, strategic sales planning and marketing measures along with public health communications is quite and very much important as well.

Limitations and recommendations

The only one limitation of the study is based on the fact that the problems of Indian population and health research have been addressed from a scientific and economic perspective that concerns the research organizations and not much from the cultural perspective.

The Research Specialist Human Resource Management (RS-HRM) should be hired or developed by the organizations and educational frameworks should be set in order to develop this specialist workforce. The other recommendation is good capital budgeting and research grant allowance practices to be adopted by the government and strong policies should be formulated to support such practices. The offline and the offline training methods should be used by the human resource (HR) in clinical research and instructor led training, simulation training, e-learning, management specific tasks, group activities and discussions as well as lectures are the recommended training methods. The mindfulness training should also be given too to the staffs and personality assessments should also be done, accordingly as well. The stress management techniques and strategies should also be used by the Human resource in clinical research, and these are virtual coffee breaks, flextime, supervision and mentoring support, fun games and counselling sessions. Performance management using evaluation techniques, quality control, employee assessment, rewards and incentives are the strategies that are needed in the clinical research framework. More academic scientists and

research scientists from the basic life sciences, translational and the implementation sciences disciplines should be recruited in a very imperative manner and diversity management techniques should be used to engage and retain the staffs of the multidisciplinary research team. A socialization and safety culture should be maintained and regular communication between the management and the staffs should also be maintained so that the conflicts and the miscommunication are prevented effectively. The technology leadership with respect to the right use of clinical research software, marketing applications, clinical trials applications, electronic health records and the electronic medical records, statistical software is required, and proper training of the research staffs is crucial. The technological training as well as the behavioral training and cultural competence plus research training for disciplinary compliance at workplace - are highly recommended as well. The final recommendation is the more collaboration of academic and industry frameworks and better interaction of government and multinational corporations to address the funding and regulatory problems with clinical research in the country. The academic institutions should be collaborating with the industries not only for large scale and long-term clinical research but also for the recruitment drives and placements for the new clinicians and scientists to get enough opportunities to become a part of the multidisciplinary clinical research team. Professionals from the field of implementation sciences, translational sciences and basic life sciences should be a part of the multidisciplinary clinical research team and recruitment plus policy development should be done, accordingly.

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