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Clinical Research in India: An Update

Bhavesh B. Patel, Sanjay Tiwari, Brahmeshwar Mishra*

Department of Pharmaceutics, Institute of Technology, Banaras Hindu University, Varanasi-221005 (U.P), India.
Address for correspondence: bmishra@bhu.ac.in

Abstract

Clinical trial is a study wherein human participants are prospectively assigned to one or more health related interventions to evaluate their effect on health outcomes and prove the quality, safety and effectiveness of a novel drug or treatment. Presence of a large pool of untreated and under-treated population, skilled doctors, trained investigators at lower cost and provision of a comprehensive framework of rules have contributed India to become an emerging hub for collaborative and outsourced clinical research. However, particular compensation and ethical care should be provided to the trial participants so that they are not treated as mere experimental models. Significant efforts are warranted to educate the professionals about pharmacogenomic and pharmacovigilance studies so as to ensure safety of the participants and minimize the possibilities of trial failure. Furthurmore, regulatory agencies, with the assistance of relevant experts, should assure that sponsors adhere to standard protocols so that interest of the clinical research workforce remains unharmed. The present communication embodies an in-depth discussion on various issues related to the clinical research.

Key words: *Clinical trial, Ethics, Pharmacogenomics, Pharmacovigilance.*

INTRODUCTION

The implementation of new drug therapy is a complex and speculative process involving two major stages; drug discovery and drug development. The first stage involves the target identification with respect to the design and synthesis of new chemical entities (NCEs). The second, drug development phase involves various preclinical and clinical tests to ensure the long-term or chronic toxicities of NCEs thus paving its path to hit the market[1,2]. Approximately 70% of the R&D cost is invested towards clinical research in drug development process. Normally, the drug development phase takes 9 to 12 years, with phase II and III clinical trials consuming half of the total time[3]. On an average, clinical data on more than 4000 patients are required by Food and Drug Administration (FDA) for the approval and commercialization of an experimental drug. Out of 5000 NCEs tested, five are recruited into clinical trial; among which just a single drug gets the marketing approval[4]. Thus, crystallization of an idea into a final product requires a research team including organic chemist, pharmacist, pharmacologist, toxicologist, clinicians as well as huge investment of about US$900 million. Several stakeholders (eg. sponsors, regulatory agencies, investigators, ethics committees, research participants, etc.) are also involved to ensure the conduct of clinical trials in ethical and scientific manner.

Clinical trials are carried out to prove the quality, safety and effectiveness of the drug. They aim to show the benefits and risks of new drugs or treatments, which is usually done by comparing them with the standard treatments in use. Human participants (patients or carefully screened healthy volunteers) are prospectively assigned to one or more health related interventions to evaluate their effect on health outcomes. Their responses are observed and recorded carefully in a time dependent manner[3]. Clinical trials have been proved useful for doctors also to find out the best way to use the available treatments, help the patients suffering from life-threatening diseases to live longer and provide them a better quality of life. Now-a-days, clinical research is growing as a trusted research field, as it is vitally necessary not only for new drugs but also for new formulations, drug delivery systems, dosage regimens, surgical and diagnostic devices and medical therapies.

Broadly, clinical trials are classified as preventive trials (to look into more beneficial ways to prevent disease in people who never had a particular disease or to prevent the relapse of a disease), screening trial (to detect certain diseases), diagnostic trial (to find out the skillful procedures for diagnosing a particular disease), treatment trial (to test an experimental treatment, new

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combinations of drugs, or new advances in medical or surgical procedures), and supportive care trials (to explore the right ways to improve comfort and the quality of life for individuals suffering from a chronic illness). An indepth discussion on various issues related to the overall clinical procedure has been embodied in this review.

Clinical trial registration

Authorized registration of clinical trials is a primary requirement for their data publication. Registration of trial promotes scientific and ethical integrity and makes the research more honest. World Health Organization (WHO) has established the International Clinical Trials Registry Platform (ICTRP) for connecting all international clinical trials registries. Clinical Trial Registry of India (CTRI) is an online and freely searchable platform wherein clinical trials being carried out in India may be registered. The initiative was started by National Institute of Medical Statistics (NIMS) of the Indian Council of Medical Research (ICMR) and is supported by Department of Science and Technology (DST) and WHO (http://www.ctri.in).

Registration is aimed to build up a public record on health products which may be drugs (herbal or synthetic), devices, vaccines, etc. It increases the awareness and answerability of the entire unit participating in clinical trial and assures public access to encourage training, help and support of such studies[5]. Till March, 2008, a total of 179 registrations have been received in CTRI, out of which 98 are from the academics (institutions and hospitals), 47 from the pharmaceutical industries and the remaining 34 from clinical research organizations (CROs)[6]. But still, national as well as global efforts to promote the registration of clinical trials have to go a long way to receive the world trust and goodwill towards their scientific and ethical integrity.

For the registration, it is essential to fill up a set of informations like target number of subjects, key trial dates, funding source, contact information for the principal investigator, primary sponsor, phase of trial, etc., (**Table 1)**. With CTRI, extra details related to the Ethical Committee (EC) or Institutional Review Board's (IRB's) and Director Controller General's of India (DCGI), permission should be attached[7]. Once the registration is submitted, the CTRI faculty verifies and validates the particulars. In case of any ambiguity, documents are sent back to the trialist for appropriate modification(s) or clarification(s). Upon successful registration, the trial is allotted a unique WHO identification number, known as International Standard Randomised Controlled Trial Number (ISRCTN), for further communications of any kind[8]. The details of registered trials are freely usable and accessible at the CTRI site.

Selection of investigator and site

Careful selection of clinical investigator and site play a pivotal role in the ethical conduct of clinical trial within the allocated fund and timelines, along with generation of quality outcomes[9]. Therefore, a significant and systematic push is needed to have appropriately trained investigators, nursing faculty, analyst and other co-workers of the clinical research unit. Government bodies and academic institutions should work hand-in-hand to design the training programmes, which must be subjected to periodic evaluation and upgradation to keep pace with the global demands. Information on training programmes, ongoing studies, industry-academia partnerships, and fellowships should be made easily accessible and readily available to the trainees. Sponsors should support the ongoing efforts to train, develop, and sustain the careers of clinical researchers.

Investigators are selected on the basis of their education, training, experience, and involvement in a specific research trial. Usually, they are fellow members of R&D consultative boards of companies, advisors to governments and members of drug approval advisory boards. It is also essential that they should have access to enough number of patients suffering from the illness to be treated[10]. Chief investigator must be a leader in the subject, with a prior experience in the trials of similar class drugs and be an expert in analyzing the study protocols to furnish his/her needful remarks.

WHO and its network place (www.who.int) is the most effective site to initiate searching of medical experts across the globe. Scientific journals and newsletters can also contribute to the selection of investigators and sites. Mumbai, Delhi, Chennai, Bangalore, and Hyderabad; five mega cities in India with their well communication and air connection, are favorite locations for the conduct of clinical trials. Each of them possesses more than 50 major hospitals; which strictly adhere to Good Clinical Practices (GCPs). Currently, approximately 80 government and privately owned Indian hospitals are engaged in global and local clinical trials[11]. Major Indian companies like Tatas, Apollo, Fortis, Max, Wockhardt, Piramal, Duncan, Ispat, Escorts have made substantial investments in setting up state-of-the-art private hospitals with world class facilities and equipments for performing clinical trial[10].

Recruitment of volunteers and patients

Volunteers and/or patients participate in clinical research programmes with the hope that their involvement would contribute to the improved health for others. Therefore, as a repay to their selfless attitude, sponsor must bear a responsibility to conduct the trial ethically and report them honestly; even the ones reflecting disprovable results[12]. They should be provided the necessary infrastructure, and be made aware of clearly defined objectives of the study. Credit must be given for their efforts and particular compensation, based on type and timeline for the study, must be provided for their contribution to the whole mankind.

Internet can be used as a perfect informant regarding market search of clinical research professionals and volunteers[13]. It is progressively being practiced to enroll healthy volunteers as well as patients into clinical trials; a process facilitated by online registration forms, e-mail, and the power to reach prominent number of possible participants through a single website. It significantly cuts down their postage and printing costs, reduces the delay in information exchange and provides the flexibility of handling potentially unlimited quantity of content. Simultaneously, description of new and currently ongoing clinical studies on various diseases worldwide can also be accessed through internet. However, ethical care to the pattern of recruitment advertisements is vitally necessary to avoid illusion and compulsion of participating research subjects[14,15].

Trial protocol

Clinical trial protocol, designed on the basis of ethical and International Conference on Harmonization-Good Clinical Practice (ICH-GCP) regulatory guidelines, is the layout of principles, policies and procedures that the research staff must follow during clinical trial. It is designed to safeguard the health of the participants as well as to answer research queries coming across[16]. A protocol generally describes the issues, like type of participants to be enrolled in the trial, schedule of test, details of drug or treatment, analytical methods, procedure, dietary requirements, supervision, and length of the study. Availability of a standard protocol permits researchers at multiple locations to perform the study in a uniform and consistent manner, so that their data can be combined and correlated. It also explains the purpose of study, proper justifications related to it, number of participants and their eligibility criteria.

Well defined exclusion and inclusion criteria, as per the ethical and regulatory guidelines applicable for a specific disease, are required while recruiting the participants from a population[17]. Inclusion criteria define the eligibility characteristics of the individuals being enrolled in the trial. Some of the inclusion criteria are; male or female specific; willingness to sign informed consent form; age; body weight, etc. Exclusion criteria are the characteristics which disqualify an individual to participate in a particular trial, eg. exclusion of pregnant and breastfeeding women from clinical studies. Similarly, if a medication is known to cause liver problems, people with damaged livers are not allowed to participate in the trial[18]. Thus, enclusion and exclusion criteria help to protect the interest of people.

Phases of Clinical Trials

Sponsor of clinical trial assembles the data regarding safety of a new drug in small-scale pre-clinical studies before it is studied in humans. Such studies provide the data regarding pharmacokinetic parameters, like absorption, distribution, metabolism, excretion and toxicity (acute as well as chronic) of a novel drug or treatment. Generally, toxicological studies are performed either in rodents or dogs[19].

After satisfactory completion of preclinical stages, clinical phase starts with a small number of subjects (healthy subjects and volunteer patients) closely observed in controlled laboratory settings and continues through hundreds of patients to thousands, before the drug is declared to be a medicine by international regulatory authorities. However, the process may be deserted at any stage for a variety of reasons, including inadequate tolerability or safety, poor efficacy, commercial pressures, etc. Once preclinical phase is completed successfully, sponsor files Investigational New Drug Application (IND) with the relevent documents to commence human trials with the drug[20]. Human experiments progress in a scientifically justified methodical manner, which is conventionally separated into four phases.

Phase I studies are primarily concerned with the assessment and evaluation of drug's safety profile and it typically takes several months. An experimental drug or treatment is tested in a small group of people (20-80) to evaluate its safety, determine a safe dosage range, and identify side effects. Several pharmacokinetic parameters like absorption, distribution, metabolism and excretion are also evaluated during this phase. Almost 70% of the experimental drugs easily pass this initial phase of testing[21].

Once a drug has been shown to be safe, it must be tested

for further efficacy. Phase II studies (therapeutic exploration phase) are aimed to determine the dose range as well as optimal dose of the drug. The drug or treatment is given to a group of 100-300 patients for the evaluation of its effectiveness and safety. Phase II studies are occasionally divided into phase IIA and phase IIB; former is planned to evaluate the dosing requirements (how much drug should be given), whereas the latter is specifically designed to analyze the efficacy of drug. It can last from several months to two years[21]. Approximately, 30% of the total experimental drugs complete both phase I and II studies successfully.

During phase III studies (therapeutic confirmation phase), drug or treatment is given to large groups of patients (250-3000). It establishes the effectiveness, monitors side effects, compares the experimental drug to commonly used alternatives, and collects information which allow it to be used safely[19]. Due to relatively large-scale patient testing, this phase provides a more clear understanding regarding drug's effectiveness, benefits and possible adverse effects. Consequently, Phase III studies typically last for several years. About 70-90% of the drugs entering phase III complete it successfully. Data gathered during animal and human studies of an IND now become a part of the New Drug Application (NDA), which is submitted to Food and Drug Administration (FDA). FDA carefully reviews the data and issues an action letter which provides an approval, approvable or non-approvable decision along with proper justification to its recommendation[20]. Upon successful completion of phase III, the sponsor can request FDA to approve the drug for marketing.

When a new drug enters the market, a large number of subjects are exposed to it. Therefore, new adverse events may be encountered. Phase IV studies (post-marketing surveillance) are carried out to observe previously unknown adverse events and risk factors. Such studies often equate a new drug with the one already in market so as to determine its long term effectiveness and pharmacoeconomics of the overall therapy. Post-marketing studies last for several years and even an approved drug can be withdrawn or recalled from the market at any stage if any life-threatening adverse effects are reported.

Design Of Clinical Trials

Randomised Controlled Trials (rcts)

Factors to be considered when designing or critically evaluating a trial are characteristics of patients, disease severity, general applicability of the results, patient size and method of monitoring[22]. Randomised controlled trial is one of the most secure method of clinical research design which provides the most obligating evidence that the study treatment causes desired effect on individual's health. It is designed to compare two or more treatments as fairly as possible, without any kind of bias. Patient group is randomized by well designed computer software, instead of decision being made by their doctor[23]. A group of patients receive the experimental drug whereas the second control group receives a standard or placebo (an inert substance that looks, tastes and smells like active drug). Randomisation helps to assure that the groups of people receiving different treatments are similar in health, age, weight, etc. RCTs find a widespread place in medical research; almost 15,000 RCTs have been reported in the year 2000[24]. Most of the phase III studies are carried out in randomised controlled manner[21]. The process of organizing and developing RCTs is long and tedious, however if done carefully, the most reliable results are obtained.

Blinded clinical trials (bcts)

In blinded trials, subjects are given both placebo and active doses in alternating periods of time throughout the study period. Participants do not know which study treatment they receive, especially when the outcome is a subjective parameter, such as pain. Simultaneous blinding of assisting physicians is also of equal importance. Accordingly, trial can be single blinded (only patients are blinded), double blinded (patients as well as physicians are blinded), or triple blinded (patients, physicians as well as investigators are blinded)[22]. "Double-dummy design", a form of double-blind study, allows additional assurance against bias or placebo effect and is especially suitable for studying the side effects of a drug during phase II studies[21].

Crossover design

In crossover study design, each patient receives two or more treatments in sequential order; with no separate comparison group. It is also called self-controlled studies because each patient serves as his/her own control for treatment comparisons. Since the same subject receives both treatments, there is less possibility of intersubject variations[26]. Some subjects receive the standard therapy first, followed by the new therapy while others receive the new therapy first, followed by the standard therapy. Though it minimises the possibilities of subject-to-subject variations, yet suffers from the demerit of possessing carry-over effects, i.e. the residual influence of treatments on concomitant treatment periods[27].

This can be avoided by separating the treatments with a 'washout period' (during which subjects receive no treatment so as to eliminate the effects of a previous treatment). Crossover design is best suited for chronic stable diseases, e.g. hypertension, chronic stable angina pectoris, etc[28].

Parallel group design

A parallel design (completely randomized trial) is one wherein the subjects are randomly assigned to treatments, which then proceed in parallel with each group. The treatment and control are simultaneously applied to two separate groups of subjects**;** hence each patient receives only a single treatment. It assures that any difference between treatments is due to treatment effects (or random chance), rather than some systematic differences between the groups of subjects. It is advantageous with the viewpoint of its simplicity and avoidance of carry-over effects. Parallel group designs are especially useful for studying the diseases which fluctuate over a short-term basis, e.g. migraine, irritable bowel syndrome, etc[29].

Multicentre studies

With a comparatively rare disease, it would not be practicable to assemble a sufficient number of patients to conduct the trial at a single centre. A multicenter clinical trial is conducted at more than one medical centers; which may be national or international. The benefits of multicenter trials include a larger number of participants, difference in geographic locations, the possibility of inclusion of a wider range of population groups, and the ability to compare results among centers, all of which increase the generalizability of the study[30]. Therefore, multi-centre studies reach at more reliable and agreed-upon conclusions at a faster rate, thus enhancing the overall progress in the treatment of a disease. Due to the involvement of patients from several centers, conclusions have a broader representative base than can be reached at a single centre. Multicentre trials can be used at any phase in clinical development; however they are of first choice during phase III studies[20].

Pharmacogenomic studies in clinical trials

Pharmacogenomics is a scientific discipline that analyzes the intact genome (full DNA sequences) responsible for fluctuation in drug reactions and therefore, is a powerful determinant of the success of drug development and therapeutics. One third of clinical trials integrate pharmacogenomic reports[31]. The study can be utilized at the drug screening phase for the identification and characterization of gene or set of gene coding for particular drug target. Advances in high-throughput genotyping brought about by pharmaco-genomic studies have reduced the technical barriers and improved the drug development strategies[32]. During preclinical phase, the study could be helpful for compound screening and distinguishing its possible side effects. During clinical phase, it may help to select the patients or volunteers on the basis of their genetic standards. The knowledge of individual's metabolizing genotype would reduce the risk of adverse drug reactions and render the dose selection more accurate[4]. For example, therapeutic regimens for anticoagulant action, psychiatry and cancer therapy are highly dependent on the pharmacogenomic condition of the patient. Recently, FDA has laid down guidelines for 'volunteer genomic data submission' (VGDS) as a part of drug development to promote the awareness of sponsors towards pharmacogenomic research during clinical trial.

Data obtained from pharmacogenomic studies can improve clinical trial pattern and offer the possibility of optimized drug prescription based on patient's genetic constitution. It can make current and successive drugs better and more efficacious by targeting them to patients who would be benefited the most. It would result into a significant reduction in the overall expenses and ensure a safe clinical protocol with much reduced chances of drug failure[33].

Pharmacovigilance in clinical trials

Pharmacovigilance is associated with the detection, assessment, understanding and prevention of adverse effects (long and/or short term)[34]. Both, clinical trial safety protocol and post marketing pharmacovigilance should remain functional throughout the life cycle of product. It would help in the evaluation, scrutinization and quantification of new drug safety; regarding its therapeutic effects, side effects, contra-indications, drug interactions, etc. It would also help patients in keeping away from unnecessary exposure to the drug.

Western countries have a systematically placed pharmacovigilance system, however, not much has been achieved in India as of today[35]. In India, regulatory decision regarding safety of drugs is conveyed by National Pharmacovigilance Program (NPP), which is sponsored and organized by Central Drugs Standard Control Organization (CDSCO)[36]. NPP possesses its own format of reporting the spontaneous adverse responses of drug. As per the provisions laid down in schedule Y act, sponsor should communicate all the unexpected serious adverse events to the licensing authority within 14

calendar days[37]. Regulatory bodies must assure that their instructions are followed both, in principle and practice. To further expedite the process of reporting, business process outsourcing units (BPOs) could be encouraged to undertake pharmacovigilance projects from multi-national companies (MNCs)[35].

Ethical issues related to clinical trials

Ethics is the application of respect, values and moral principles to human activities, whereas bioethics is related to the use of ethical principles in medicine and biology[38]. Ethical principles constitute an integral part of clinical practice as it involves human beings, who may or may not get benefit, or may come across certain potential unweighed risks[39]. Therefore, coverage of ethical approval in published reports indicates the knowledge and sensitivity about ethical aspects of the research[40]. ICMR has laid down a set of ethical guidelines for biomedical research in human beings. All the institutions in India, pursuing any form of biomedical research demanding human being, must follow these guidelines to defend the safety and welfare of research participants[41]. Ethical conduct of a clinical trial does not finish with the preparation of study protocol and getting signature of participants on the informed consent form. It is equally essential to protect the rights, interests, and safety of research subjects during the study period. People in India are not educated enough and therefore, are unaware of their rights. Stringent steps must be taken to ensure that the sponsors adopt the highest level of safety and ethics. According to ICH-GCP, an IRB should escort safely the rights and well-being of all trial participants, which includes initial and in-process evaluation of the study protocol and related documents, review of reports of unanticipated problems and adverse events[42]. More importantly, particular care should be provided to the trials which involve more susceptible subjects, such as pregnant women, children, prisoners, the elderly, or persons with weakened comprehension. Simultaneously, approval of new CROs must be done only on the basis of their quality certification[43,44].

Clinical research in india

Recent data show that 86% of clinical studies in US fail to enroll the expected number of participants, either due to shortage of patients or of investigators and therefore, on an average, their market entry gets delayed for around one year. For each day a product is delayed in getting into market, one million dollars are lost in gross. This necessitated the sponsors to outsource their clinical research to some other emerging markets. With almost one billion people as potential patients and a large number of highly skilled investigators, it is judged that nearly 30% of all global clinical trials will be conducted in India by next five years[45]**.** Presence of such a large untreated and undertreated population, skilled doctors and trained English-speaking investigators at lower cost are the obvious advantages for carrying out clinical research in India (**Table 2**). Implementation of world-class laws on intellectual property rights and provision of a comprehensive framework of rules has encouraged MNCs to import technology into India to develop new drug products[46]. More importantly, data from clinical studies done in India have also been successfully filed with international regulatory agencies, like US-FDA[45]. According to official reports, about 100 trials were approved in the country in 2005. The count grew to 150 in 2006, 240 in 2007 and 450 in 2008[47]. Currently, more than 226 FDA-approved clinical trials are in progress in India **(Figs. 1 and 2)**. It is assumed that over the succeeding years, up to 65% of FDA-regulated clinical trials will be conducted outside the US and, India would be the most favoured location[48]. A significant number of multinational CROs have set up their operational plants in Indian market (**Table 3**). Services offered by CROs include, clinical trial management (preclinical through phase IV), clinical, medical and safety supervising, toxicology, biostatistics and medical writing during the preparation of a New Drug Application (NDA), Abbreviated New Drug Application (ANDA), Biologics License Application (BLA), regulatory affairs support, and other complimentary involvements.

Table 1. List of registration parameters (as per CTRI database)

Field	Description
UTRN WHO*	Universal Trial Reference Number
Title of Study WHO*	Provided in a comprehensive language
Scientific Title of Study WHO*	As has been submitted in the protocol for funding and ethical review
Principal investigator's name and address	Address includes telephone and fax numbers, and email id
Contact Person (Scientific/ public query)WHO	Email address, telephone and fax no., postal address, and affiliation of the person
Primary and secondary sponsor WHO	To ensure proper registration of the trial
Countries of Recruitment WHO	The countries from which participants are intended to be or have been recruited
Site/s of study	List of all site/s within the country including the site address
Name of Ethics Committee and approval status*	Ethics committee approval documents are forwarded to CTRI, NIMS
Regulatory clearance obtained from DCGI*	Approval letter is forwarded to CTRI, NIMS
Health condition/ problem studied WHO	Statement of the primary health condition(s) or problem(s) being studied
Study type WHO	Whether the study is single arm, controlled non-randomized or randomized controlled one
Primary and secondary outcome/s WHO	Events, variables, or experiences which have been measured
Target sample size WHO	Total number of participants intended to be enrolled in the trial
Phase of trial*	Phase of investigation, usually applied to drug trials
Date of first enrollment WHO	Anticipated or actual date of enrollment of the first participant
Estimated duration of trial	Expected duration of the trial; starting from the first enrollment to the final report submission
Status of trial WHO*	**Not yet recruiting**: Yet to initiate patient enrollment **Open to recruitment**: Participants are currently being recruited and enrolled **Terminated**: Enrollment of participants has halted and will not resume **Completed**: Recruitment of participants and data analysis is complete

** Mandatory field*

Table 2. Factors contributing India as a global hub for clinical trials

Factors	Reference(s)
World's second number of population; a large pool of genetically different patients	19,50
Availability of English speaking doctors and highly experienced clinical investigators	50
Less than 30% of global costs; well furnished medical institutions, hospitals and CROs	2
Implementation of ICH-GCP guidelines and emergence of new IPR regime with GATT/WTO/TRIPS	49
Reliable clinical data quality as per the standards of US-FDA	47
Effective broadcasting and information systems	50

Abbreviations: *GATT - General Agreement on Tariffs and Trade, WTO - World Trade Organization, TRIPS - Trade Related Intellectual Property Rights*

Table 3. List of specialized CROs in India

Sr. No.	Name	Location
1	Accutest Research Laboratories (I) Pvt. Ltd.	Mumbai
2	Apothecaries Ltd.	New Delhi
3	B.A Research Ltd.	Ahmedabad
4	B.V. Patel (PERD) Research	Ahmedabad
5	ClinSearch Ltd.	Ahmedabad
6	Clinigene International Pvt. Ltd.	Bangalore
7	ClinInvent Research Pvt. Ltd.	Mumbai
8	ClinTec International Ltd.	Bangalore
9	iGATE Clinical Research International Pvt. Ltd.	Mumbai
10	ICON Plc.	Chennai
11	Jubilant Clinsys Ltd.	Noida
12	Lambda Therapeutic Research Ltd.	Ahmedabad
13	Lotus Labs Pvt. Ltd.	Chennai
14	Manipal Acunova Ltd.	Bangalore
15	Neeman Medical International	New Delhi
16	Quintiles Spectral Ltd.	Ahmedabad
17	Sipra Labs Pvt. Ltd.	Hyderabad
18	Suven Life Sciences Ltd.	Hyderabad
19	Synchron Research Services Pvt. Ltd.	Ahmedabad
20	Veeda Clinical Research Ltd.	Ahmedabad

Figure 1. Global clinical studies; last updated on 24th January, 2009 (Source: www.clinicaltrial.gov)

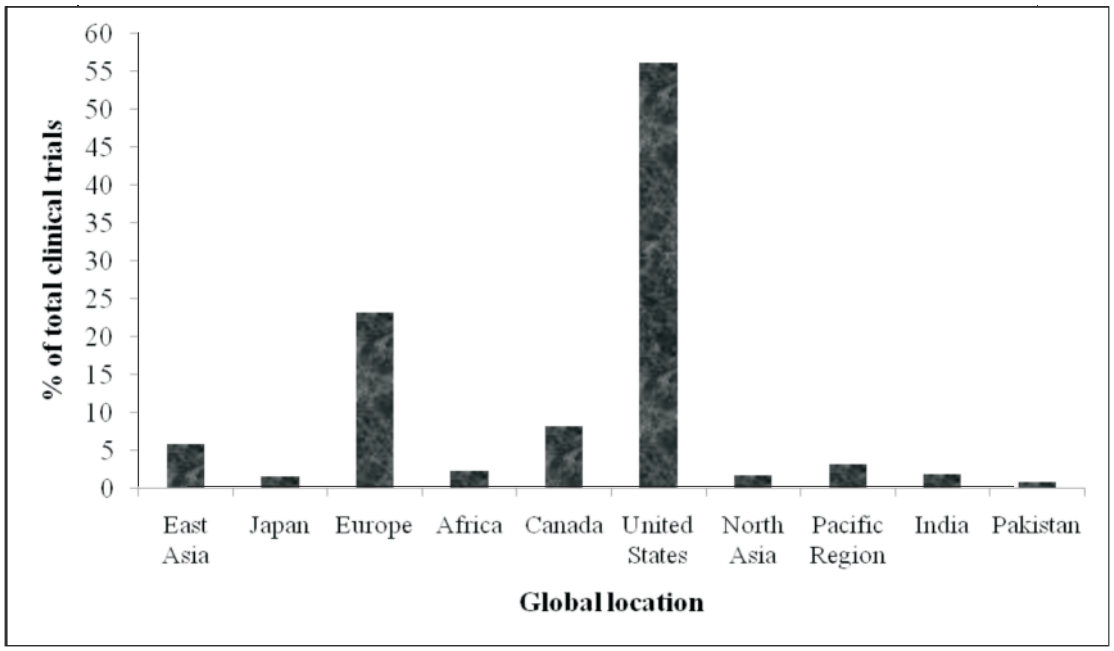
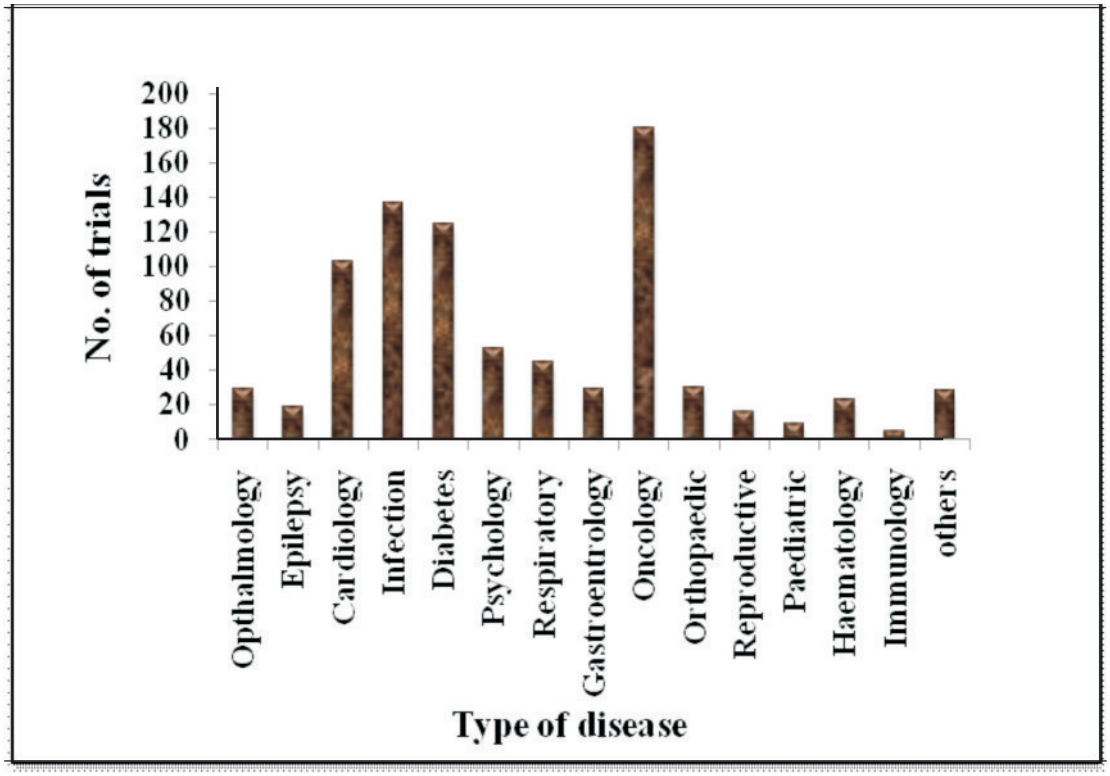


Figure 2. Clinical studies carried out in India; last updated on 24th January, 2009 (Sources: *http://www.clinicaltrial.gov; http://www.ctri.in)*



CONCLUSION

Since quality is the trademark of global acceptance, sponsors and clinical research organizations should invest heavily in monitoring, investigator training and quality control of clinical research. To cater the increased demands and gain a foothold in the global pharmaceutical market, two core activities warrant special attention; creation of a learning environment related to the practice of clinical research and internationalization of pharmacy education system by facilitating student exchange programs with the countries having state-of-the-art facilities. Significant efforts are also demanded to educate the professionals about the benefits of using pharmacogenomics and pharmacovigilance studies to ensure safety of the participants and minimize the possibilities of trial failure. Particular compensation and ethical care should be provided to the trial participants so that they are not treated as mere experimental models. People in India are not educated enough and unaware of their rights. Therefore, stringent steps must be taken to ensure that sponsors adopt the highest level of safety and ethics. Furthurmore, regulatory agencies, with the assistance of relevant experts, should assure that sponsors adhere to standard methodology and protocols so that interest of the clinical research workforce remains unharmed.

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