International Journal of Zoology, Environment and Life Sciences
Content Available at www.lapinjournals.com ISSN (O): 3048-9598
(An International online peer reviewed Referred Journal)
Review Article Open Access

PHARMACOVIGILANCE IN CLINICAL TRAILS

Jada Bhavani*, P.Nisha, Budagala. Gayathri, Dr.Chandu Babu Rao
Priyadharshini Institute of Pharmaceutical Education and Research, 5th Mile, Pulladigunta, Guntur- 522017, Andhra Pradesh, India

Article History: Received: 04 May 2025, Revised: 19 May 2025, Accepted: 04 June 2025

***Corresponding author**
Jada Bhavani

DOI: https://doi.org/10.70604/ijzels.v2i2.53

Background:
Pharmacovigilance, the science and activities related to the detection, assessment, understanding, and prevention of adverse effects or any other drug- related problems, is intrinsically linked to effective information management. The pivotal role of information in pharmacovigilance encompassing data collection, analysis, and dissemination for optimal patient safety. The foundation of pharmacovigilance lies in robust information system that facilitate the collection of adverse event reports from health-care professionals, Patients, and other stake holders' Major purpose of pharmacovigilance is to gauge the benefit- risk profile of drug for better efficacy and safety to be used in patients. Pharmacovigilance plays a major role in rationale use of drug which provides the information about the adverse drug reactions which seen in patients. In terms of volume Indian Pharma industry is third largest in world and in terms of value id thirteen largest in world. India is also known as a hub for clinical research and drug development. A critical component throughout the drug development life- cycle is monitoring patient safety.

Keywords: Pharmacovigilance, Clinical trials, Safety monitoring, stake holders, Participant safety, Monitoring, reporting, Adverse events, Data integrity, Benefits and risks.

Introduction

The historical development of word " pharmacovigilance" includes the Greek word phannacon= drug or medicinal substance and the Latin word Vigilare = 'to keep watch'. Absolutely, pharmacovigilance is indeed a critical aspect of the entire drug development process. It involves the constant monitoring, assessment, and understanding of potential adverse effects or any issues related to. medications. This helps ensure patient safety by evaluating this risks and benefits associated with specific drugs. With the aid of information technology, pharmacovigilance has significantly improved, allowing for more efficient monitoring and enhancing clinical safety practices. It's a pivotal part of ensuring the safety, efficacy and cost effectiveness of medications throughout their life cycle from discovery to post- marketing surveillance. The clinical trial process is regulated by the specific regulatory guidelines (ICH GCP, USFDA guidelines etc). Clinical trials give the evidential base for regulatory approvals of safe and effective medicines. 6 GCP is that the "standard for the conducting, performance, planning, monitoring, recording, auditing, analyses and reporting of clinical trials that gives assurance that the info and reported results are believable and accurate which rights, integrity and confidentiality of trial subjects are protected".7Safety evaluation may be a central component altogether stages of the drug development life-cycle. The primary objective of pharmacovigilance in clinical trials is to monitor and evaluate the safety profile of investigational product [1].

History

1. **Thalidomide Tragedy (1950s-1960s)**: Thalidomide, Originally prescribed as a sedative and anti-emetic, caused severe birth defects in thousands of infants. This catastrophe underscored the necessity for systemic monitoring of drug safety.
The aftermath led to increased awareness of the potential harm drugs could cause, especially during pregnancy.
2. **Formation of WHO Program (1968)**: In response to the thalidomide incident, WHO established the international Drug Monitoring Program in 1968. This program laid the foundation for a global network of

pharmacovigilance centers, fostering collaboration in collecting and analyzing data on adverse drug reactions (ADRs).

3. **FDA and AERS (1970s)**: The FDA initiated the Adverse Event reporting system (AERs) in1970s. AERs become a pivotal tool for collecting, managing, and analyzing data on adverse events associated with drugs, enabling the FDA to monitor and regulate drug safety in United States [2].

What is Pharmacovigilance

The World Health Organization defines pharmacovigilance (PV) as "It is a pharmacological science which deals with safety of drugs and activity which concern to assess, detect, understand and prevent adverse effects or the drug-related problem." The aim of PV is to reinforce patient safety concerning medicine use by providing a system to collect, evaluate, and distribute drug safety data [3].

Pharmacovigilance in Clinical Trials

Pharmacovigilance may be a process of continuous monitoring and evaluation of all adverse events during drug development process, to make sure the security of the participants and a continuing assessment of the risk and the benefit. Majority of safety information considered before market authorization springs from controlled clinical test. The clinical test process is regulated by the precise regulatory guidelines (e.g ICH GCP, USFDA guidelines etc) [3]. Pharmacovigilance, also referred to as drug safety, is the science of understanding the adverse effects caused by a drug and assessing whether the benefit will outweigh the risk [4].

Pharmacovigilance Processes in Clinical Trials

Pre-trial planning and safety assessment

Prior to the initiation of a clinical trial, thorough pre-trial planning takes place. This involves designing the study protocol, selecting appropriate study populations, and conducting comprehensive safety assessments. Safety assessments typically involve a review of pre clinical data, previous clinical trial results, and available information on the investigational product to identify potential risks and determine safety monitoring requirements.

Adverse event monitoring and reporting

Adverse event monitoring is a critical component of pharmacovigilance in clinical trials. It involves the systematic collection, documentation, and analysis of adverse events or any other untoward medical occurrences experienced by trial participants. Adverse events can range from mild to severe and include both expected and unexpected reactions. Rigorous monitoring allows for the early detection of safety signals and the timely implementation of risk management strategies. Adverse events are reported according to regulatory requirements and guidelines, ensuring the timely and accurate submission of safety data [6].

Timelines for Reporting

Timely reporting of adverse events is a cornerstone of pharmacovigilance. Regulatory agencies, such as the FDA and EMA, provide specific timeline for reporting, with expedited requirements for serious and unexpected events. These timelines ensure that potential safety concerns are addressed promptly, minimizing risks to patients [6].

Data collection and management

Proper data collection and management are crucial to pharmacovigilance in clinical trials. Robust systems and procedures are established to ensure the accurate and consistent collection of safety data. This may involve the use of standardized case report forms (CRFs) or electronic data capture (EDC) systems.

Data collection and management

Proper data collection and management are crucial to pharmacovigilance in clinical trials. Robust systems and procedures are established to ensure the accurate and consistent collection of safety data. This may involve the use of standardized case report forms (CRFs) or electronic data capture (EDC) systems. Data management includes processes such as data entry, coding of adverse events, and quality control measures to maintain the integrity and reliability of the collected data.

Data Collection Methods

Electronic Health Records: Electronic health records (EHRs) have become invaluable sources of pharmacovigilance data. Integration with EHR systems allows for the continuous monitoring of patient outcomes. EHRs also facilitate the linkage of patient demographics, medical history, and medication use, providing a comprehensive view of the patient's healthcare journey [7].

Data Processing

Quality Control

Ensuring the quality of pharmacovigilance data is paramount. Rigorous quality

Control measures, including data validation checks, consistency checks, and data reconciliation, are implemented to maintain the integrity and accuracy of the collected information. Data discrepancies or anomalies are thoroughly investigated to ensure the reliability of safety data [8].

Stakeholders in Safety Monitoring Sponsor

Clinical trial sponsors, normally pharmaceutical companies, are obligated for development of the clinical trial protocol. The protocol mark out every aspect of the research, by taking consideration of the rationale for the experiment, objectives, trial population with elaborated exclusion and inclusion criteria, investigational therapies administration, trial procedures, data collection standards, endpoints and sample size.

Subjects: Subjects are patients or healthy volunteers who agree to participate in a clinical trial and have signed the Informed Consent Form. With else information, the ICF

gives important safety info so the subjects can take an informed decision on whether to participate in the trial [9].

Investigators: Investigator is qualified individuals who are skilled and experienced to give medical care to subjects registered in the trial. Investigators determine potential subjects and educate them about the trial participation to see that if they can make an informed decision. While the trial is ongoing, investigators are supposed to follow up to the protocol treatment plan in delivering care.

Institutional review board/ Ethics committee: The Institutional Review Board (IRB), also well known as the ethics committee, is charged with protecting the rights and welfare of human subjects enlisted to participate in research protocols conducted under the endorsement of the institution to which the IRB is affiliated [10].

Emerging Trends and Technologies in Pharmacovigilance in Clinical Trials

- **Utilization of electronic data capture systems and e-health technologies**

Electronic data capture (EDC) systems are increasingly being used to collect, manage, and analyze data in clinical trials. EDC systems streamline data collection processes, reduce errors, and facilitate real-time data access and analysis. In addition, e-health technologies, such as mobile apps, wearable devices, and remote monitoring tools, are being integrated into clinical trials to capture real-time patient-reported outcomes, adherence data, and physiological measurements. These technologies enable more efficient and comprehensive data collection, enhancing pharmacovigilance practices.

- **Integration of real-world evidence and patient-centered outcomes**

The integration of real-world evidence (RWE) and patient-centered outcomes is gaining prominence in pharmacovigilance. RWE utilizes data from real-world clinical practice, electronic health records, claims databases, and patient registries to provide additional insights into the safety profile of investigational products. Patient-centered outcomes focus on the perspectives and experiences of patients, allowing for a more comprehensive assessment of drug safety and efficacy.

Application of data analytics, artificial intelligence, and machine learning:

Data analytics, artificial intelligence (AI), and machine learning (ML) techniques are being leveraged to improve signal detection and risk assessment in pharmacovigilance. These technologies enable the analysis of large volumes of data, identification of patterns, and detection of safety signals that may go unnoticed with traditional methods. AI and ML algorithms can automate the detection of adverse events, classify and code safety data, and predict potential risks. They also facilitate data mining of various data sources, such as social media and electronic health records, for early identification of safety concerns.

- **Enhanced data visualization and interactive dashboards**

Advanced data visualization techniques and interactive dashboards are being employed to present safety data in a more user-friendly and actionable manner. These tools allow for the visual exploration of adverse events, safety trends, and risk patterns. Interactive dashboards enable users to customize data views, drill down into specific subsets of data, and generate real-time reports. Enhanced data visualization facilitates better understanding and interpretation of safety data, aiding in timely decision making and risk management.

- **Use of natural language processing (NLP) for adverse event detection:**

Natural language processing (NLP) techniques are utilized to automate the extraction of relevant information from unstructured text, such as electronic medical records, clinical notes, and scientific literature. NLP algorithms can identify and extract adverse event information, facilitating efficient adverse event detection and analysis. By automating the process of adverse event identification from text sources, NLP contributes to the timely identification and reporting of safety signals.

- **Pharmacogenomics and personalized medicine approaches**

Pharmacogenomics, the study of how an individual's genetic makeup influences their response to drugs, is increasingly integrated into pharmacovigilance practices. By considering genetic variations and individual susceptibility to adverse drug reactions, personalized medicine approaches can help identify individuals at higher risk of developing adverse events. This allows for tailored monitoring and risk management strategies, optimizing participant safety in clinical trials [11].

Future Directions

Real-time monitoring and proactive pharmaco vigilance: Advancements in technology can enable real time monitoring of safety data, allowing for proactive identification and management of safety signals. Continuous monitoring of patient data, integrating wearable devices, and utilizing real-world evidence can enhance safety surveillance during clinical trials.

Integration of artificial intelligence and machine learning: Further integration of artificial intelligence (AI) and machine learning (ML) techniques can support automated adverse event detection, signal identification, and risk prediction. AI algorithms can analyze large data-sets, identify patterns, and generate real-time safety alerts, improving the efficiency and accuracy of pharmacovigilance processes.

Use of real-world data and evidence

The integration of real-world data (RWD) and real-world evidence (RWE) can provide a broader perspective on drug safety and effectiveness. Leveraging RWD from electronic health records, claims databases, and patient registries can complement clinical trial Data and provide valuable insights into the long-term safety profile of investigational drugs [12].

Collaboration and data sharing

Strengthening collaboration and data sharing among stakeholders, including researchers, regulatory authorities, and industry sponsors, can improve the efficiency and effectiveness of pharmacovigilance. Sharing safety data, adverse event reports, and safety analysis findings can facilitate a more comprehensive understanding of drug safety and enable early detection of potential risks. Addressing these challenges and embracing future directions in pharmacovigilance can lead to improved participant safety, more efficient detection of safety signals, and better-informed risk management decisions during clinical trials. By adopting innovative technologies, promoting collaboration, and prioritizing participant-cantered approaches, pharmacovigilance.

Benefit-Risk Assessment in Clinical Trials

Benefit-risk assessment is a crucial step in the evaluation of investigational drugs during clinical trials. It involves a systematic evaluation of the potential benefits and risks associated with the use of the investigational product. Here are the key aspects of benefit-risk assessment in clinical trials:

Balancing Potential Benefits and Risks

Benefit-risk assessment aims to strike a balance between the potential benefits of the investigational drug and the risks it may pose to trial participants. The potential benefits include therapeutic efficacy, improved health outcomes, disease management, or enhanced quality of life. Risks encompass any potential adverse effects, complications, or safety concerns that may arise from the use of the drug. Evaluating the balance between benefits and risks is essential for determining whether the potential benefits outweigh the potential risks.

Evaluation of Safety Endpoints and Efficacy Outcomes

Benefit-risk assessment involves the evaluation of safety endpoints and efficacy outcomes measured during the clinical trial. Safety endpoints focus on monitoring and assessing the occurrence and severity of adverse events, while efficacy outcomes measure the drug's intended therapeutic effects and its ability to achieve desired clinical outcomes. Both safety and efficacy data are analyzed and compared to determine the overall benefit-risk profile of the investigational product.

Role of pharmacovigilance in identifying safety signals

Pharmacovigilance plays a significant role in benefit-risk assessment by actively monitoring and identifying safety signals during clinical trials. Safety signals are indications of potential risks or new safety concerns associated with the investigational drug. Through systematic adverse event monitoring, analysis, and signal detection techniques, pharmacovigilance helps identify emerging safety issues, enabling timely risk assessment and management.

Making risk management decisions:

Benefit-risk assessment informs the decision-making process regarding risk management strategies. If potential risks are identified, various risk mitigation measures can be implemented to minimize the occurrence or impact of adverse events. These may include dose adjustments, patient monitoring, safety monitoring committees, or modifications to the trial design or inclusion/exclusion criteria. By assessing the potential benefits and risks, appropriate risk management decisions can be made to ensure participant safety and maximize the benefit-risk balance.

Real-world Evidence in Pharmacovigilance:

Pragmatic Trials

Pragmatic trials, designed to reflect real-world clinical scenarios, have gained Prominence. These trials aim to evaluate the efficacy and security of medications in diverse patient populations, incorporating real-world complexities and variability. The findings from pragmatic trials contribute valuable information to pharmacovigilance efforts [13].

Patient-centered Pharmacovigilance

Patient-reported Outcomes (PROs)

Emphasizing a patient-centered approach, pharmacovigilance increasingly incorporates patient-reported outcomes (PROs). Patients provide insights into their experiences with medications, including the impact on their quality of life. PROs contribute valuable information to assess the overall benefit-risk profile of drugs.

Direct Patient Reporting

Direct patient reporting of adverse events is gaining prominence as a means to capture real- world experiences. Initiatives encouraging patients to report adverse events directly to regulatory authorities or through designated platforms contribute to a more patient-centric pharmacovigilance system [14].

Conclusion

The information to assess the safety profile of drug is given by pharmacovigilance. Participation of professionals of health care country wide to report adverse drug reaction or adverse events plays a major role in the success of pharmacovigilance. Current progress in Pharmacovigilance is well-marked by increase in use of

databases to make the process more proactive and organized. It must be in everyone's priority to develop safe and effective medicines to patients. During clinical trials monitoring patient safety is a critical component throughout the drug development life- cycle. To ensure a systematic approach of safety monitoring pharmaceutical sponsor must work proactively and collaboratively with all stakeholders. For risk management plans, risk evaluation and minimization strategies. There will be greater demand for more comprehensive and innovative approaches that apply quantitative methods to collecting data from all sources, ranging from the discovery and preclinical through with clinical and post-approval stages, as the industry transitions from passive to active safety surveillance activities.

Author Contributions

All authors are contributed equally

Financial Support

None

Declaration of Competing Interest

The Authors have no Conflicts of Interest to Declare.

Acknowledgements

None

Reference

1. Kanala K, Hwisa NT, Chandu BR, Assaleh FH, Mukkanti K, Katakam P, Challa BS. Simultaneous quantification of mesalamine and its metabolite N-acetyl mesalamine in human plasma by LC-MS/MS and its application to a bioequivalence study. British Journal of Pharmaceutical Research. 2014 Jul 1;4(13):1568.https://www.ijpsjournal.com
2. Härmark LV. Web-based intensive monitoring: a patient based pharmacovigilance tool.https://doi.org/10.36713/epra15259
3. Mastroianni PC, Varallo FB, Dagli-Hernandes C. Brazilian regulation in pharmacovigilance: a review. Pharm Regul Aff. 2016;5:164..: http://dx.doi.org/10.47583/ijpsrr.2021.v70i01.002
4. Silar S, Suryaprabha M, Chandu B, Nama S, Irfan P, Pathapati H, Pisipati SV. FEATAL ALCOHOL SYNDROME. http://dx.doi.org/10.47583/ijpsrr.2021.v70i01.002
5. Singh BG, Baburao C, Pispati V, Pathipati H, Muthy N, Prassana SR, Rathode BG. Carbon nanotubes. A novel drug delivery system. International Journal of Research in Pharmacy and Chemistry. 2012;2(2):523-32. *https://link.springer.com/article/10.1007/s40264-018-0647-1*,
6. Pisipati SV, Pathapati H, Bhukya G, Nuthakki S, Chandu B, Nama S, Adeps R. Lycopene: Redress for prostate cancer. Journal of basic and clinical pharmacy. 2012 May 15;3(2):261. https://link.springer.com/article/10.2165/00002018-200427080-00008
7. Franklin JM, Glynn RJ, Martin D, Schneeweiss S. Evaluating the use of nonrandomized real-world data analyses for regulatory decision making. Clinical Pharmacology & Therapeutics. 2019 Apr;105(4):867-77. https://doi.org/10.1002/cpt.1351
8. Chisholm O, Sharry P, Phillips L. Multi-criteria decision analysis for benefit-risk analysis by national regulatory authorities. Frontiers in medicine. 2022 Jan 12;8:820335. https://doi.org/10.1002/cpt.1351
9. Grady C. Payment of clinical research subjects. The Journal of clinical investigation. 2005 Jul 1;115(7):1681-7. https://www.ijpsjournal.com
10. Archdeacon P, Grandinetti C, Vega JM, Balderson D, Kramer JM. Optimizing expedited safety reporting for drugs and biologics subject to an investigational new drug application. Therapeutic innovation & regulatory science. 2014 Mar;48(2):200-7. https://doi.org/10.1177/2168479018768514
11. Textbooks P. Textbooks on pharmacovigilance may cover topics related to participant safety in clinical trials. Examples include "Pharmacovigilance: Principles and Database Systems" by Patrick Waller and "Pharmacovigilance: A Practical Approach" by Ronald D. Mann. https://doi.org/10.1002/9780471462422.eoct064
12. Textbooks P. Textbooks on pharmacovigilance may cover topics related to participant safety in clinical trials. Examples include "Pharmacovigilance: Principles and Database Systems" by Patrick Waller and "Pharmacovigilance: A Practical Approach" by Ronald D. Mann. https://doi.org/10.1002/9780471462422.eoct064
13. Dasari V, Awen BZ, Chandu BR, Khagga M. In-Vitro and In-Vivo Evaluation of Multi Unit Stavudine Gastroretentive Dosage Forms. Research Journal of Pharmaceutical Dosage Forms and Technology. 2010;2(5):344-53. https://doi.org/10.1002/9780471462422.eoct064
14. Goldstein BA, Navar AM, Pencina MJ, Ioannidis JP. Opportunities and challenges in developing risk prediction models with electronic health records data: a systematic review. Journal of the American Medical Informatics Association: JAMIA. 2016 May 17;24(1):198.. https://doi.org/10.1002/9780471462422.eoct064