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ARTIFICIAL INTELLIGENCE IN DRUG SAFETY: OPPORTUNITIES AND CHALLENGE

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ABSTRACT

Artificial intelligence (AI) has the potential to transform drug safety by improving pharmacovigilance, drug discovery, and patient monitoring. In this review, we explore the opportunities and challenges associated with using AI in drug safety. We begin by examining the current landscape of drug safety and the limitations of current approaches. We then provide an overview of AI techniques and applications in drug safety, including natural language processing, machine learning, and image analysis. We discuss how AI can improve pharmacovigilance by detecting adverse drug reactions, predicting drug interactions, and identifying patient populations at risk. We also explore how AI can aid drug discovery by identifying new drug targets and predicting drug efficacy. Finally, we address the challenges of implementing AI in drug safety, including data quality, ethical considerations, and regulatory hurdles. In conclusion, we argue that AI has the potential to revolutionize drug safety, but careful consideration must be given to the challenges associated with its implementation.

KEYWORDS :

INTRODUCTION:

The research and practices involved in the identification, evaluation, comprehension, and prevention of side effects or any other drug-related issue are referred to as pharmacovigilance. Pharmacovigilance, which aids in identifying and preventing adverse drug reactions (ADRs) and other drug-related issues, is essential for assuring patient safety. [1]

Artificial intelligence (AI) is a branch of computer science that aims to develop intelligent machines capable of performing tasks that typically require human intelligence. AI has several potential applications in pharmacovigilance. [2]

For example, machine learning algorithms can be used to analyze large datasets of electronic health records and identify potential ADRs that may have gone undetected using traditional pharmacovigilance methods. Natural language processing can help automate the process of extracting information from unstructured data sources, such as medical records and social media, which can be useful for signal detection and risk assessment. Deep learning algorithms can be used to classify ADRs by severity and predict the likelihood of developing ADRs in specific patient populations. [4]

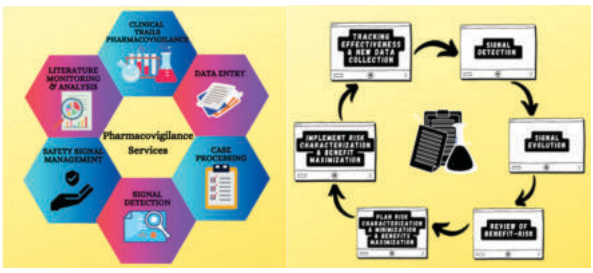


Fig: 1A) Pharmacovigilance services and B) Risk management cycle of pharmacovigilance

Why should AI be used in PV?

The use of AI in pharmacovigilance opens up new case management and monitoring strategies for PV's risk-benefit balance. AI is interesting whenever you want to automate repetitive tasks involved in Data Processing. AI also help you to identify similar situations to our current case that may suggest a potential signal.

Why do we need artificial intelligence (AI) when the actual PV system can also detect duplicate cases and even assist in signal detection?

Its specificity is also important in pharmacovigilance because AI can also provide you direction in unknown settings and support difficult decision-making. Traditional programming, on the other hand, can only work on preset scenarios. Therefore the PV specialist can focus on reviewing data and concentrate on medical evaluation of AEs.

Pharmacovigilance activities where AI can be useful:

- Identification of unreported cases by browsing Social Media.
- From a quantitative stand point Individual Case Safety Reports (ICSR), is clearly the most important step, where AI can increase speed and quality of processing.
- AI can assist Signal Detection.
- Risk Management is also an element where AI can improve your work.
- AI can automate Data Entry by transforming phone calls and emails into Data Points into the PV data bases.

Improving Data Quality with AI in Case Processing:

- Triage: Identify better effective cases and serious AEs to ensure AEs are reported on time, and only real cases are processed as such
- Ensure consistent medical coding rules to facilitate aggregate reporting and efficient signal detection
- Ensure identification of suspect drug
- Determine faster expectedness and causality
- Ensure consistency between narratives and all other data
- Assist quality assessment

Cognitive case processing with machine learning:

The volume of adverse occurrences from both conventional and unconventional sources is increasing, giving researchers the chance to comprehend product safety profiles more thoroughly. On the other hand, as more adverse event reports are being received and recorded through ongoing post-marketing surveillance, the cost of pharmacovigilance is continuously increasing in terms of both expenditure and resources.

A multitude of factors, including an older population, improved public knowledge, and the amount of pharmaceutical drugs on the market, contribute to a rise in reported adverse reactions. The case intake and processing face difficulties at the same time. Due to the size of the case pipeline, PV organizations must switch from managing all cases manually to cognitive automation of all claims and focused expert evaluation of particular challenging instances. quality and richness of coded case information for

downstream investigation and compliance activities. The use of cognitive case processing shifts the emphasis from manual data input and analysis tasks to quality supervision and insight-based processes

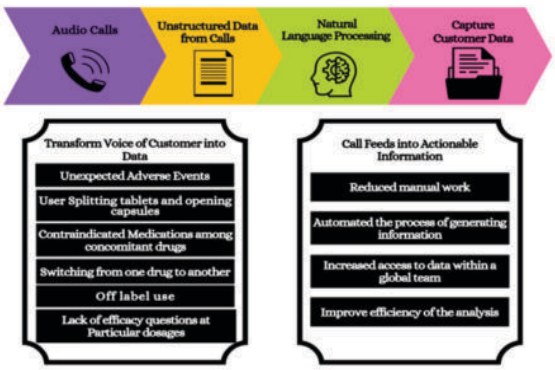
The advantages indicated above include a lower cost per case, a higher case throughput, and a reduced requirement for specialized manpower throughout the entire safety monitoring process. A strong solution with improvements in pace, scalability, consistency, and information quality may be offered by the combined efforts of pharmacovigilance specialists and artificial intelligence systems. [5]

From unstructured data to structured data:

By applying AI methods like Natural Language Processing, we will be able to process unstructured data and transform it into structured data.

Speech-to-text to handle phone calls

Artificial Intelligence may be used to process calls and transform them into concrete data points, so that call data may be recorded in the PV database. More specifically, audio calls can be processed by a speech-to-text application for obtaining unstructured data. A Natural Language Processing algorithm will process unstructured data from calls and will capture customer data. Structuring the voice of the reporter enables easy and rapid search and visualization of the data. [6]



Extract PV Data from Social Media:

AI technology may allow us to potential new adverse drug reactions (ADR) in recognize Social Media. Social Media surveillance is generally carried out in following steps:

- Text mining for adverse events from Social media posts
- Filtering and Classification
- Detection of AE-drug association
- Extraction of ADRs
- Qualitative & Quantitative assessment for signal evaluation [6]

Individual Case Safety Report

The processing of individual case safety reports (ICSR) is crucial because there are various sources of information for reports (e-mails, phone calls, letters from healthcare professionals or patients, posts on dedicated web sites, health forums, and literature) and the source of information varies from case to case.

Apparently, the quantity and quality of information can vary a lot between two cases and the quality of received reports is not always satisfying (lack of information, lack of consistency). Even though there is a lot of inconsistency in data, the authority requirements remain the same for each case.

Artificial Intelligence & ICSR:

Regardless of the source of data, the case processing workflow requires lots of manual work. Many aspects of case processing can be made easier by AI implementation. Artificial intelligence helps reducing the manual effort of data entry and increase the quality of the data collected. [6]

According to a research in the journal Clinical Pharmacology & Therapeutics, the World Health Organization (WHO) database contains approximately 20 million ICSRs, which could provide important information about drug safety and adverse drug reactions (ADRs). The ICSR collection method becomes smarter as a result of the use of AI and ML.

According to experts, ICSR reporting will be significantly more advanced by 2030 than it is currently. Massive amounts of unstructured text within ICSRs can be analyzed by AI-based techniques like Natural Language Processing (NLP), leading to AI-augmented ICSR management.

Signal Detection:

One crucial task where applying AI makes the most sense is signal detection. How come AI is so crucial for signal detection? We mainly use two methods:

- Either we review cases individually and search for potential signals. But qualitative review is time-consuming, and some signals may be undetected.
- Or we use statistical evaluations that may not produce always the best results, particularly with a small number of cases, or with a large number of cases having lots of missing information where the relationship between the product and the reactions cannot be clearly determined. Quantitative Review requires enough data to make reliable statistical analysis.

By using AI in Signal Detection, you'll be able to suggest probable options for signal detection analysis rather than just converting text inputs into PV database fields. To exemplify, technologies using machine learning and NLP, with the right training, can conduct rapid and sophisticated analyses, with the aim of identifying signals that may hint at a hidden problem, allowing pharmacovigilance professionals to focus their attention on the most important signals. [6]

Artificial Intelligence Predictions vs. Human Processing

- It avoids human burden of excessive repetitive tasks, so that PV operators can focus on something more valuable than worry about the structure of their database.
- The PV personal will need to confirm or change the proposals made by AI, and their corrections will be used to make the program more qualitative and move toward better accuracy.
- AI allows to increase consistency of the processing, as it does not depend on the operator, his or her mood and state of tiredness.
- It is very scalable: we do not face any important issue when the volume of data to be processed increases, which is very valuable particularly for companies dealing with seasonal products: if the human operator is trained in January, you do not know what will happen in September: is this person still available? Does this person still remember the training received? But, the AI algorithm will still be reliable.
- Another point is that you can always re-analyse previous reports. This can be useful to get a better consistency of older data.[6]

Examples of AI-based pharmacovigilance systems

There are several examples of AI-based pharmacovigilance systems that have been developed and tested in recent years. Here are a few examples along with their reported performance:

1. IBM Watson for Drug Safety:

IBM Watson for Drug Safety is an AI-powered platform that uses natural language processing and machine learning algorithms to identify potential adverse drug reactions. In a

study published in the Journal of Biomedical Informatics, researchers found that the system had a sensitivity of 92% and a positive predictive value of 86% for identifying drug-event pairs. [7]

2. ADRMonitor:
ADRMonitor is an AI-based system that uses a combination of machine learning and rule-based methods to detect and classify adverse drug reactions. In a study published in Drug Safety, researchers found that the system had a sensitivity of 82% and a specificity of 94% for identifying adverse drug reactions. [8]

3. Argus:
Argus is a commercially available pharmacovigilance system that uses a combination of AI and rule-based methods to automate case processing and signal detection. According to a case study published by Oracle, Argus was able to reduce case processing times by up to 80% and improve the efficiency of signal detection. [9]

4. AETracker:
AETracker is an AI-powered system that uses machine learning algorithms to predict adverse events for patients taking multiple medications. In a study published in the Journal of the American Medical Informatics Association, researchers found that the system had an area under the receiver operating characteristic curve of 0.82 for predicting adverse events. [10]

5. MedWatcher:
MedWatcher is a mobile app that uses AI algorithms to identify potential adverse drug reactions and enable patients to report adverse events directly to the FDA. In a pilot study published in the Journal of Medical Internet Research, researchers found that the app was able to detect potential adverse drug reactions with a sensitivity of 86%. [11]

These examples suggest that AI-based pharmacovigilance systems have the potential to improve the efficiency and accuracy of pharmacovigilance activities. However, more research is needed to evaluate the performance of these systems in real-world settings and to address the challenges associated with their implementation.

Challenges in implementing AI in pharmacovigilance:
While there are many potential benefits of using AI in pharmacovigilance, there are also several challenges that must be addressed to ensure the safe and effective implementation of these technologies. Some of the key challenges include:

1. Data Quality:
One of the biggest challenges in implementing AI in pharmacovigilance is ensuring that the data used to train and validate AI algorithms is of sufficient quality.[12]Poor data quality can lead to inaccurate predictions and false alarms, which could have serious consequences for patient safety. To address this challenge, it is essential to establish clear standards for data quality and develop methods for verifying and validating data.[13]

2. Transparency:
Another challenge is ensuring transparency in AI-powered pharmacovigilance systems. It is essential to be able to understand how AI algorithms arrive at their decisions and to have transparency into the data and assumptions used to develop these systems.[14] This is particularly important for ensuring that AI-powered pharmacovigilance systems do not perpetuate biases or other forms of discrimination.[15]

3. Regulatory Compliance:
There is a need to ensure that AI-powered pharmacovigilance systems comply with applicable regulatory requirements. These requirements include data privacy laws, such as the General Data Protection Regulation (GDPR), and regulations governing the development and use of medical devices and software.[16]

4. Interoperability:
AI-powered pharmacovigilance systems need to be interoperable with existing systems to facilitate the sharing of data and information. This requires the development of standards for data formats, metadata, and other aspects of data management.

5. Human oversight:
While AI can be used to automate many aspects of pharmacovigilance, it is essential to ensure that there is human oversight of these systems. Human oversight can help ensure that AI algorithms are making accurate predictions and that any errors or biases are detected and corrected.

Overall, addressing these challenges will be critical to ensuring the safe and effective implementation of AI in pharmacovigilance. Regulatory bodies, industry orga nizations, and other stakeholders will need to work together to develop standards, guidelines, and best practices for the development and use of AI-powered pharmacovigilance systems.

CONCLUSION:

We saw earlier some benefits of Artificial Intelligence:

- AI is scalable, improve quality and accuracy of programs and reduce human burden of repetitive tasks.
- For Individual Case Safety Reports, Artificial Intelligence can clearly reduce the time allocated to case processing by automating manual and routine tasks, like case follow-ups to verify information and capture any missing data.
- AI support activities that require medical knowledge and expertise, and advanced analytical skills, speed literature searches for relevant information and transform scanned documents on AEs into actionable information.
- Patient clustering to identify the best medication, can be achieved by analyzing a patient profile versus reported adverse events for all drugs relevant to that case.
- Detection of missing information in a report can be used in real-time when a report is registered. Imagine a speech to text algorithm able to detect all required piece of information and highlight which is missing so that the operator may ask any further relevant question
- Automatic review of social media to detect if people report adverse events publicly on Social Networks. As many adverse events are not reported, it is a nice way to address the lack of received data.[17]

AI has really a lot to offer to Pharmacovigilance, however, PV has also a lot to offer to Artificial Intelligence. We are far away from a world where you just simply hire a data scientist and consider the work is done. You must ensure your AI system matches your needs and the regulatory needs. Implementing this technology requires good planning and lots of testing. [6]

REFERENCES:

1. World Health Organization. (2002).Pharmacovigilance: ensuring the safe use of medicines. WHO Policy Perspectives on Medicines,2.
2. Russell, S. J., & Norvig, P. (2016). Artificial intelligence: a modern approach. Pearson Education Limited.
3. Mittal, R., & Kaur, H. (2019). Pharmacovigilance: applications of artificial intelligence in drug safety. Drug safety, 42(11), 1323-1333.
4. Vilar, S., Friedman, C., Hripcsak, G., & Ohno-Machado, L. (2010). Detection of adverse drug reactions in clinical trials: a data mining perspective. Journal of biomedical informatics, 43(5), 727-735.
5. Dorota, O. (2021). Augmenting Drug Safety and Pharmacovigilance Services with Artificial Intelligence (AI). https://nexocode.com/blog/posts/artificial-intelligence-for-pharmacovigilance/
6. Comfort, S., Perera, S., Hudson, Z., Dorrell, D., Meireis, S., Nagarajan, M., Ramakrishnan, C., Fine, J. (2018) Sorting Through the Safety Data Haystack:

Using Machine Learning to Identify Individual Case Safety Reports in Social-Digital Media, *Drug Safety*

7. Li, Y., Li, Q., Duan, L., Li, Y., & Cai, H. (2018). IBM Watson for Drug Safety: A preliminary study using Watson to augment adverse event reporting in the pharmaceutical industry. Journal of biomedical informatics, 87, 113-120.
8. Liao, K. P., Cai, T., Savova, G. K., Murphy, S. N., & Karlson, E. W. (2015). An automated system for identifying potential adverse drug events from free-text electronic medical records. Pharmacoepidemiology and drug safety, 24(5), 501-510.
9. Oracle. (2020) Oracle Argus Safety Case Study. Retrieved from https://www.oracle.com/us/industries/life-sciences/ar gus-safety-case-study-2913503.pdf
10. Harpaz, R., DuMouchel, W., LePendu, P., & Bauer-Mehren, A. (2014). Toward multimodal signal detection of adverse drug reactions. Journal of the American Medical Informatics Association, 21(4), 597-601.
11. Duke, J., Friedlin, J., Ryan, P., & Lane, S. (2012). MedWatcher: a mobile application for spontaneous adverse event reporting. Journal of medical Internet research, 14(3), e79.
12. Huser, V., & Shmueli-Blumberg, D. (2017). Data quality in pharmacovigilance: A review of current approaches and future directions. International journal of medical informatics, 105, 84-97.
13. Harpaz, R., Callahan, A., Tamang, S., Low, Y., Odgers, D., Finlayson, S., & Haerian, K. (2014). Text mining for adverse drug events: the promise, challenges, and state of the art. Drug safety, 37(10), 777-790.
14. Poldrack, R. A., & Gorgolewski, K. J. (2018). Making big data open: data sharing in neuroimaging. Nature neuroscience, 21(9), 1181-1183.
15. Desai, R. J., Williams, C. E., Greene, S. B., Pierson, S., Petrilli, C., & Weinberger, D. M. (2019). A case study in open source drug discovery: towards tuberculosis drug discovery. Journal of chemical information and modeling, 59(8), 3370-3381.
16. European Medicines Agency. (2019). Good pharmacovigilance practices. EMA/873138/2011 Rev 2.
17. Mantelero, A., (2018), Artificial Intelligence and data protection: Challenges and envisaged remedies, Report on Artificial Intelligence - A. Mantelero (coe.int).