Agentic AI in healthcare

Daan de Jong

Supervised by Marc Teunis on behalf of university of applied sciences, Utrecht, the Netherlands

ABSTRACT

The weight of evidence (WoE) process in toxicology is crucial for understanding how substances cause harm, but it is time-consuming and prone to human error due to the vast amount of information researchers must assess. When a substance is identified as toxic, WoE evaluations help determine whether existing literature explains its effects. While AI-driven solutions exist, little research has explored conversational agents to support this process. This study investigates the research question: How can conversational agents guide the weight of evidence approach in toxicology? We hypothesize that integrating conversational agents will streamline WoE assessments, reducing time and human error. To test this, we develop a proof-of-concept chatbot using Python, LangChain, and LangGraph to assist researchers in evaluating toxicological evidence. It is tested on existing review data to measure its effectiveness. If successful, this research could enhance decision-making, improve evidence reliability, and reduce animal testing, demonstrating the potential of AI-driven tools in toxicology and regulatory science.

LITERATUREREVIEW

The weight of evidence (WoE) methodology is crucial in toxicology for assessing the reliability of scientific data regarding the harmful effects of substances. Traditional WoE evaluations are time-consuming and prone to errors, highlighting the need for more efficient methods[1]. The shift towards New Approach Methodologies (NAMs), such as in-vitro and in-silico methods, emphasizes the role of mechanistic insights and data analysis[2]. Artificial Intelligence (AI) and Natural Language Processing (NLP) are being employed to expedite data processing[2]. NLP can analyze large volumes of scientific literature and optimize Adverse Outcome Pathway (AOP) networks, which describe causal relationships between molecular initiating events (MIEs) and adverse outcomes (AOs) [2]. Quantifying the reliability of these networks using WoE methods is essential for reliable risk assessment[1]. Conversational agents (chatbots), powered by NLP, can simulate human conversations, access knowledge bases, and provide personalized interactions[3].

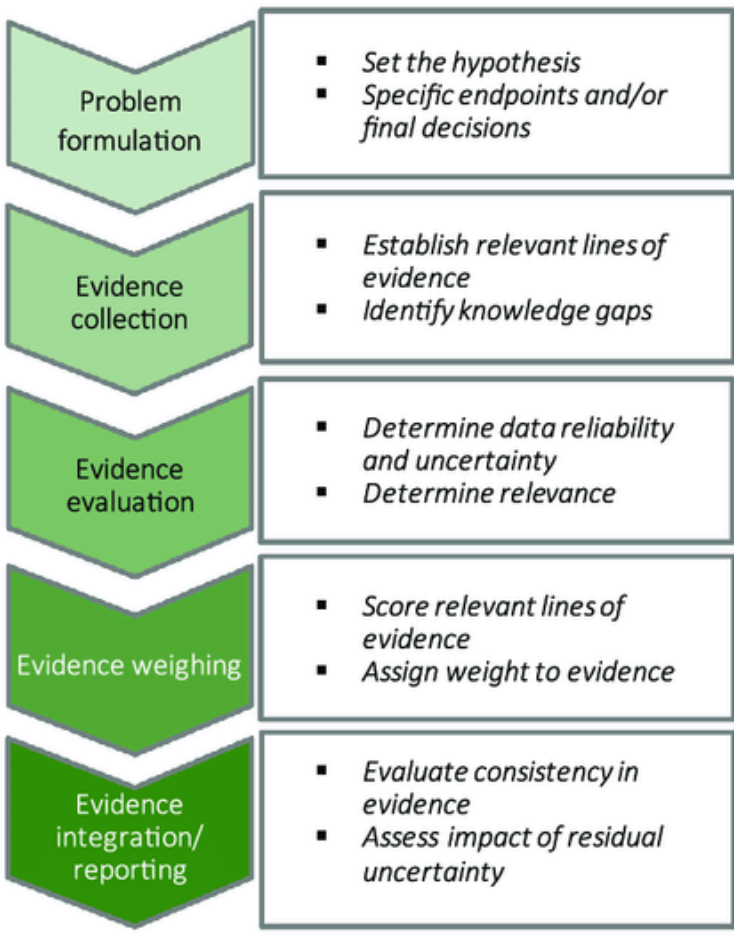

Fig. 1. Schematic of a weight-of-evidence approach [4]

They can process complex information but have limitations in handling open discussions and generating logical responses[3]. Argumentation-based chatbots use computational argumentation for more transparent reasoning, supporting the development of strategic and consistent dialogues[3]. While research exists on AI and NLP for AOP networks, there is limited research on the direct application of chatbots to guide the WoE process in toxicology [1], [2]. This research explores the potential of chatbots for streamlining the WoE process, reducing human errors, and increasing the efficiency of data analysis[1], [2]. The intended result is that the integration of chatbots will contribute to a more reliable and efficient evaluation of toxicological data, paving the way for more ethical evaluations[1].

RESEARCH METHODOLOGY

This 10-week study will develop and evaluate a conversational agent to assist in the weight of evidence (WoE) process in toxicology. The research begins with interviews and desk research to understand toxicology workflows and agentic AI, ensuring a solid foundation for system design. A proof of concept (PoC) conversational agent will then be developed using Python, LangChain, and LangGraph, selected for their ability to create structured, interactive AI models.

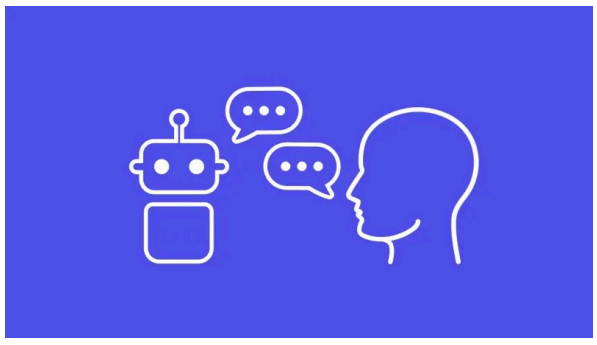

Fig. 2. Conversational artificial intelligence illustration

To test and validate the PoC, data from a completed evidence review—including scientific papers and an existing WoE assessment—will be used. The system's performance will be evaluated based on its ability to enhance efficiency, reduce human error, and streamline the WoE process.

PRELIMINARY CONSIDERATIONS

This research aims to streamline the weight of evidence (WoE) process in toxicology by reducing time and human error through conversational agents. If successful, it could enhance evidence reliability, support alternative testing methods, and help reduce animal testing. Additionally, by improving research efficiency, it may minimize wasted resources and optimize scientific funding allocation.

CONCLUSIONS

This research explores using conversational agents to streamline the weight of evidence (WoE) process in toxicology, improving efficiency and reducing human error. By leveraging AI-driven technologies, the study aims to develop a proof-of-concept system that enhances evidence assessments. It specifically seeks to reduce the time needed for WoE evaluations and minimize human error in decision-making.

If successful, this research could reduce animal testing by improving evaluation accuracy and minimize wasted resources in scientific research.

References.

[1] A. Verhoeven et al., "A quantitative weight-of-evidence method for confidence assessment of adverse outcome pathway networks: A case study on chemical-induced liver steatosis," Toxicology, vol. 505, p. 153814, Jun. 2024, doi: 10.1016/j.tox.2024.153814.

[2} M. P. F. Corradi et al., "Natural language processing in toxicology: Delineating adverse outcome pathways and guiding the application of new approach methodologies," Biomater. Biosyst., vol. 7, p. 100061, Aug. 2022, doi: 10.1016/j.bbiosy.2022.100061.

[3] F. Castagna, N. Kökciyan, I. Sassoon, S. Parsons, and E. Sklar, "Computational Argumentation-based Chatbots: A Survey," J. Artif. Intell. Res., vol. 80, pp. 1271–1310, Aug. 2024, doi: 10.1613/jair.1.15407.

[4] A. D. Redman et al., "Moving persistence assessments into the 21st century: A role for weight-of-evidence and overall persistence," Integr. Environ. Assess. Manag., vol. 18, no. 4, pp. 868–887, Nov. 2021, doi: 10.1002/ieam.4548.

Acknowledgements. The HCAIM (the Human-Centred AI Master's Programme) Project is Co-Financed by the Connecting Europe Facility of the European Union Under Grant №CEF-TC-2020-1 Digital Skills 2020-EU-IA-0068. This Poster Was Created As Part of the Blended IP Event Organized Under Erasmus + Programme of the European Union.