Addressing the Challenges of Artificial Intelligence used for Data Extraction in Systematic Literature Reviews

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Foreword

Systematic, HTA-compliant review of literature is a fundamental aspect of health economics and outcomes research (HEOR). Forming part of this process is the data extraction in systematic literature reviews (SLRs), and its subsequent evaluation for use as part of a data-driven evidence package. Harnessing artificial intelligence (AI) to drive efficiencies, effectiveness, and precision in the SLR process can provide opportunities to increase and expand time and resource allocation at the evidence evaluation stage, to deliver potentially greater insights for the evidence package. However, with this opportunity comes challenges and considerations that require oversight and close engagement of experienced practitioners who can leverage the technologies. Through Parexel's experience of implementing AI into the SLR process, we have identified five areas of focus that are critical to address the use of AI for data extraction in SLRs and ensure their use as a valuable and ethical tool for synthesizing and evaluating the evidence on a particular topic is fully realized.

- Wyatt Gotbetter, SVP and Global Head Parexel Access Consulting

Summary

Artificial intelligence (AI) has the potential to significantly improve the efficiency of data extraction for systematic reviews (SLR), which are critical for synthesizing the evidence on the effectiveness and safety of healthcare interventions. However, the use of AI to extract clinical data from scientific literature for SLRs also raises several challenges that need to be carefully considered and integrated into the practices of experienced experts, fluent in the best practices of evidence evaluation.

The challenges for the use of AI in SLRs	
Data quality	If the data used to train the AI is of poor quality or biased, the AI may make incorrect or biased decisions
Lack of transparency	It can be difficult for humans to fully understand how AI algorithms make their decisions, leading to a lack of transparency in the extraction process.
Limited coverage	AI systems may not be able to extract data from all types of scientific literature,
Data extraction	and it may be difficult for AI systems to accurately capture all the relevant information
Ethical considerations	AI in systematic reviews raises ethical considerations, such as the potential for bias and the need for transparency in the decision-making process

Conclusion

With AI's potential to significantly improve the efficiency and accuracy of data extraction for systematic reviews comes challenges in its use. To address these challenges and ensure the responsible and transparent use of AI in systematic reviews, it is important to carefully design and test the AI algorithms, to use a diverse and representative sample of data, and to consider the ethical implications of using AI in this context. The human intelligence, the human subject matter expert still plays the most important role in data extraction, AI tools cannot be used without careful and thoughtful human supervision.

Introduction

SLRs are an established method for synthesizing and evaluating evidence on a particular topic. They involve a systematic and transparent process for identifying, selecting, and extracting data from relevant studies, and for synthesizing and analyzing the data to draw conclusions about the topic being studied. Data extraction is a critical step in the SLR process, as it involves identifying and extracting the relevant data from each study in a standardized format.

Data extraction can be a time-consuming process that is open to error when done manually, particularly for large and complex reviews. It requires skilled reviewers to carefully read and interpret each study, and to accurately identify and extract the relevant data. This can be challenging, as studies may present data in various formats, including tables, graphs, and text, and it can be difficult to capture all the relevant information accurately. In addition, the sheer volume of studies that may be included in a large SLR can make manual data extraction an overwhelming and labor-intensive task.

To address these challenges, researchers are increasingly turning to AI as a tool for data extraction in SLRs. AI algorithms can be trained to recognize and extract specific types of data, and to accurately interpret and organize the data in a standardized format. This can significantly reduce the time and effort required for data extraction and can help to minimize errors and omissions, but is only as good as the strategies, expertise and perspectives applied by the researcher.

The five dimensions of AI use and their challenges

1: Data Quality

Challenge

Data quality is a critical factor in the use of AI to extract clinical data from scientific literature for systematic reviews. Systematic reviews are an important tool for synthesizing evidence on the effectiveness and safety of healthcare interventions, and the accuracy and reliability of the data extracted from the literature informs the validity of the review.

If the data used to train the AI is of poor quality or biased, the AI may make incorrect or biased decisions, which can lead to inaccurate or misleading results in the systematic review. Poor quality data can include data that is incomplete, ambiguous, or otherwise unreliable. Bias can occur when the data used to train the AI is not representative of the population of interest, or when the data reflects the preferences or biases of the people who collected or recorded it.

Solution

To ensure the quality of the data used to train the AI, it is important to select and pre-process the data carefully. This can include steps such as verifying the accuracy and completeness of the data, removing duplicate or irrelevant data, and standardizing the data to ensure that it is in a consistent format. It is also important to use a diverse and representative sample of data, to ensure that the AI is trained on a broad range of data that reflects the diversity of the population of interest.

Ensuring the quality of the data used to train the AI is essential for ensuring the accuracy and reliability of the data extractions made by the AI. This can help to ensure that the systematic review is based on high-quality evidence, which is critical for informing clinical practice and policy.

2: Lack of transparency

Challenge

Lack of transparency in the decision-making process of AI algorithms can be a challenge when using AI to extract clinical data from scientific literature for systematic reviews. It can be difficult for humans to fully understand how AI algorithms make their decisions, leading to a lack of transparency in the extraction process.

This lack of transparency can be problematic for several reasons. First, it can be difficult for reviewers to understand the basis for the decisions made, making it challenging to determine whether the AI is making accurate and reliable extractions. This can impact the reliability and validity of the systematic review, as it may be difficult to identify and correct any errors or biases in the data extractions.

Second, the lack of transparency can also raise concerns about the accountability and fairness of the extraction process. If reviewers cannot understand how the AI is making its decisions, it may be difficult to hold the AI accountable for any errors or biases in the extractions. This can be particularly problematic if the AI makes decisions that have significant consequences for patients or other stakeholders.

Third, it is important for an SLR to be reproducible using the approach used by the reviewer. This can be challenging if the decision-making process of the AI algorithms is not transparent.

Solution

The use of explainable AI algorithms, which are designed to provide explanations for their decisions in a way that is understandable to humans, can ensure that the AI algorithms used in systematic reviews are transparent. Reviewers can better understand the basis for the AI decisions, which can help to improve the transparency and accountability of the extraction process.

❯❯❯ 3: Limited coverage

Challenge

AI systems may not be able to extract data from all types of scientific literature, such as non-English language articles or data in formats as graphs, images, and not in standardized tables. This can limit the coverage of the systematic review and potentially exclude important evidence.

Solution

To address this challenge, it may be necessary to use a combination of AI and human review to ensure that all relevant literature is included in the systematic review. This can involve using AI to extract data from articles in standard formats and using human reviewers to extract data from non-standard formats or articles in non-English languages and also to verify the accuracy and completeness of the extractions. This can help to ensure that the extractions are accurate and reliable, and that all relevant data is included in the review.

Another approach is to use AI to extract data from articles in standard formats, and to use human reviewers to verify the accuracy and completeness of the extractions. This can help to ensure that the extractions are accurate and reliable, and that all relevant data is included in the review.

❯❯❯ 4: Data extraction

Challenge

Extracting clinical data from scientific literature can be a complex task, as it involves identifying and extracting specific pieces of information from a large volume of text. This complexity can present a challenge when using AI to extract data for systematic reviews, as AI systems may have difficulty accurately recognizing and capturing all relevant information.

One aspect of this complexity is the wide variety of data that may need to be extracted for a systematic review. Clinical data may include information on the interventions being studied, the study design and population, the measured outcomes, and the study results. Extracting this diverse range of data requires the AI to accurately identify and extract specific pieces of information from a large volume of text/tables/images and even supplementary material.

Another aspect of the complexity is the potential for variability in how information is presented in scientific literature. Different authors may use different terminology, formatting, or structures to present the same information, which can make it difficult for the AI to identify and extract the relevant data accurately.

Solution

To address these challenges and ensure the accuracy and reliability of the data extractions, it is important to carefully design and test the AI algorithms used in the extraction process. This involves selecting an appropriate AI algorithm for the task and ensuring that it is properly trained and tested on a representative sample of data. It may also be necessary to fine-tune the AI algorithm to improve its performance and accuracy.

Using a combination of AI and human review can help to ensure that the systematic review is comprehensive and includes all relevant evidence. It can also help to mitigate the risks associated with using AI alone, such as the potential for bias or lack of transparency in the extraction process.

5: Ethics

Challenge

In addition to concerns about bias and transparency, the use of AI for decision-making support also raises questions about responsibility and accountability. Who is responsible and accountable for the decisions made by the AI? It is important to carefully consider these questions and to ensure that there is a clear understanding of who is responsible and accountable for the decisions made by the AI.

AI algorithms may be biased if the data used to train them is biased, or if the algorithms are designed or implemented in a biased manner. This can lead to biased or discriminatory decision-making by the AI, which can have serious consequences for the individuals affected by these decisions. For example, if an AI algorithm used to make hiring decisions is biased against certain groups of people, this could result in discrimination in the workplace. To address this ethical concern, it is important to ensure that the data used to train the AI is diverse and representative and to design and test the AI algorithms to minimize bias.

Another ethical concern is the lack of transparency in the decision-making process of AI algorithms. It can be difficult for humans to fully understand how AI algorithms make their decisions, leading to a lack of transparency in the decision-making process. This can be problematic, as it may be difficult for individuals to understand the basis for the decisions made by the AI, and to determine whether the AI is making accurate and reliable decisions. To address this ethical concern, it is important to ensure that the AI algorithms used for decision-making support are transparent and explainable so that individuals can understand the basis for the AI's decisions.

Solution

Overall, using AI for decision-making support raises several ethical considerations, including the potential for bias, the need for transparency, and the issue of responsibility and accountability. One way to address these ethical concerns is to ensure that the AI algorithms used for decision-making support are designed and implemented in a transparent and explainable manner, so that individuals can understand the basis for the AI's decisions. Also, consider the potential impacts of AI-based decisions on different groups to ensure that the AI algorithms do not perpetuate or exacerbate existing inequalities or biases. Additionally, it is important to establish clear mechanisms for accountability and recourse in cases where the AI's decisions have negative consequences. By carefully considering these ethical considerations, we can ensure that the use of AI for decision-making support is done responsibly and ethically.
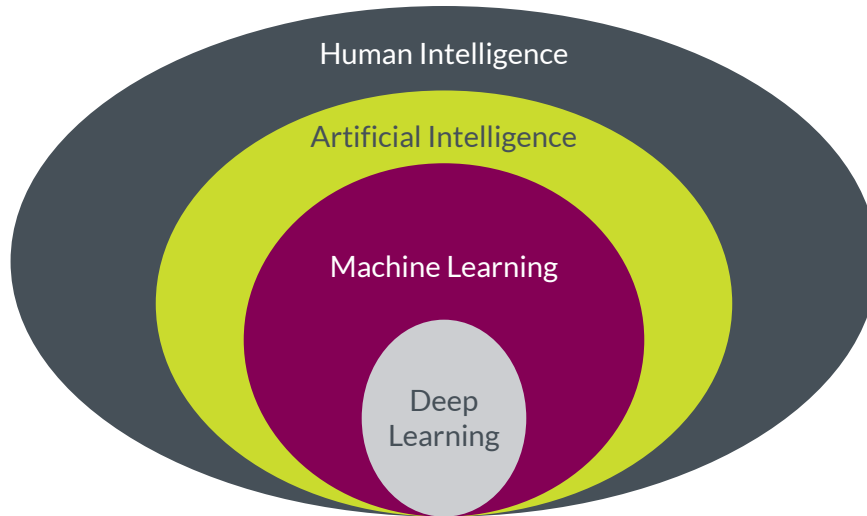
Human intelligence is superior to AI, ML, and DL

›› Conclusion

The use of AI for data extraction in SLRs has the potential to significantly improve the efficiency and accuracy of the process. With automation, and reducing the need for manual review, AI can help to reduce time and effort and help to minimize errors and omissions. However, using AI in this context also raises challenges and ethical considerations, which are important to consider carefully. To ensure that the use of AI for data extraction in SLRs is a valuable and ethical tool for synthesizing and evaluating the evidence on a particular topic, we must address these challenges and ethical considerations. Human intelligence, the human subject matter expert still plays the most important role in data extraction, and AI tools cannot be used without our careful supervision.

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for a conversation

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