Artificial Intelligence Technologies to Develop a "Causal Research Assistant"

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The investigators will develop an approach for applying recent advances in causal artificial intelligence (CAI) and large language models (LLMs) such as ChatGPT, to assist authors in pre-review, critical thinking, and revision of causal analyses and interpretations in write-ups of scientific articles and reports dealing with potential adverse health effects of exposures. This project will include presentation and discussion of methods to (a) critically examine, evaluate, and summarize the evidence and reasoning supporting causal statements and conclusions about exposure-associated risks in scientific papers; and (b) make concrete, constructive suggestions for improving aspects of causal inference methodology including study design, data analysis, and causal interpretation of conclusions. It is envisioned that the Causal Research Assistant will be able to transparently document the basis for its evaluation of methodological strengths and limitations and its suggestions for improvements for draft and final research manuscripts and reports. This project is at the forefront of applying modern AI to delineate and improve causal conclusions in scientific studies by exploring facts, data, and independently reproducible and verifiable observations and presenting these in a manner that distinguishes them from other elements such as modeling assumptions and choices, judgments or preconceptions that are not empirically implied by or derived from the data and analyses presented.

The project resulted in the development of the method which was published in Global Epidemiology: "An AI assistant to help review and improve causal reasoning in epidemiological documents" Global Epidemiology, Volume 7, 2024, 100130, ISSN 2590-1133, https://doi.org/10.1016/j.gloepi.2023.100130. A pilot study was initiated to formally evaluate the AI assistant to help authors and peer reviewers of papers submitted to the journal Global Epidemiology. However, this pilot study was curtailed due to limited participation. Additional testing is underway in other venues and once completed, the results will be used to improve the method..

This research project was expanded in September 2024 to develop the AIA2 system ("AIA2") which is intended to allow users to upload clusters of related papers (peer-reviewed journal articles addressing claimed health effects of exposures to specific chemicals) and receive back individual reviews of each paper, as well as AIA2's analysis of common themes and differences across papers. The major near-term goal of this work is to develop a paper discussing how to use AIA2 (and modern AI more generally) to automate as far as possible (ideally, entirely) the production of substantive analysis and synthesis and constructive comments and suggestions on the evidence and causal reasoning and conclusions in sets or clusters of scientific articles addressing exposure-associated health effects.

Based on the progress made with the AIA2 system, the research was expanded in April 2025 to develop the AI-STROBE-Plus system to automate analysis of STROBE criteria and more recent criteria for valid statistical analysis and causal inference in observational epidemiological studies. The STROBE (STrengthening the Reporting of OBservational studies in Epidemiology) initiative developed specific recommendations and a list of the elements and information / data that should be included in an accurate and complete report of an observational study. Accordingly, a key purpose of this expanded research project is to develop, test, and illustrate the practical application to real epidemiology papers of AIA-STROBE-Plus by applying AI-STROBE-Plus to 5–7 observational epidemiological studies or sets of studies relevant to regulatory risk assessment. **Implications**: The Causal Research Assistant will advance automated critical reasoning approaches with the aim of improving the scientific basis and credibility of objective causal inference analyses for use in product stewardship and regulatory decision making.

Project start and end dates: September 2023 – June 2026

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