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The Impact of GenAI on Health Economics: Observations and Applications

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INTRODUCTION

- Generative AI (GenAI) is increasingly transforming the pharmaceutical and healthcare industries, introducing innovative solutions to complex challenges.[1,2] In health economic and outcomes research (HEOR), GenAI has the potential to streamline processes and improve decision-making accuracy through applications such as predictive analytics and automation of research processes.[3,4]
- AI and GenAI tools have already proven useful in some aspects of HEOR, including automating literature reviews, conducting complex statistical analyses, and synthesizing large datasets.[5,6]
- Although still in its early stages, GenAI presents unique opportunities to improve the cost-effectiveness in health economic modelling by automating model construction, enabling real-time updates, supporting replication, and optimizing simulation processes, which can enhance accuracy, efficiency, and reproducibility while reducing the time and resources required for development.[7,8,9]

OBJECTIVES

- The objective of this study was to review how GenAI has been applied in health economic modelling, identifying early use cases and highlighting the challenges and potential for GenAI to advance the field further.

METHODS

- **Literature Search and Database Selection**: A comprehensive literature review was conducted using the EMBASE database to identify studies involving cost-effectiveness models (CEM) developed entirely or with the support of GenAI. The search focused on the application of GenAI in health economic modelling without any time restrictions. Searches were run in April 2024 and updated in Oct 2024 to ensure completeness of the results.
- **Inclusion of Popular GenAI Tools**: The search strategy targeted widely used GenAI tools applicable to health economic modelling, including GPT, Copilot, Jasper, CodeWhisperer, Perplexity, Midjourney, Vertex, and Gemini. The terms specific to GenAI tools were combined with ones related to HE models, selected based on recommendations by HTA agencies.[10]
- **Screening and Selection Process**: Titles and abstracts were independently screened by two reviewers to ensure unbiased selection. Studies were included if they directly applied GenAI in cost-effectiveness modelling or discussed theoretical applications within HEOR. Full-text reviews were conducted on studies meeting eligibility criteria.

RESULTS

- The search identified a total of 461 titles and abstracted (204 of which as part of the Oct 2024 update) which were screened by two independent reviewers. 14 studies were included for full text review and 4 were included in the final analysis. All of the included studies were published in the past year.

CEM development:

- Reason et al.[11] explored the use of GPT-4 for the **development of partition survival models in R**. Two published health economic models, (for non-small cell lung cancer (NSCLC) and renal cell carcinoma (RCC)) were replicated using carefully developed prompts that described each model's methods, assumptions, and parameters.
- Findings: Results showed **high accuracy**, with 100% of the NSCLC models containing no errors or only minor ones, and 93% being completely error-free. For RCC models, 87% were error-free or had a single minor error, and 60% were completely error-free. A **human intervention was required** to simplify input calculations in the RCC model. In both cases, the error-free scripts closely replicated published ICERs within 1% of the original values.

CEM adaptation

- Rawlison et al.[12] aimed to **adapt an existing MS-Excel model** based on an existing CEM developed for the UK setting to be used for an HTA submission in the Czech Republic. Natural language instructions and tabular data were provided to GPT-4 to update input values in the Excel **parameter sheet** without using cell references. All edits were highlighted to **facilitate quality checking**.
- Findings: GPT-4 updated 62/64 required updates with overall accuracy of **97%.** The errors were present in the updates of the **drug acquisition and administration costs (2/11 i.e 82% accuracy)**, which were not set to 0. The update of the inputs related to adverse events, resource costs and proportion of subsequent treatments were all implemented with 100% accuracy.

Early cost-effectiveness assessment:

- Srivastava et al.[13] explored the potential use of **GPT-4 in early modelling**. GPT-4 was used to analyse and synthesize data from clinical trial reports, epidemiological studies, and existing economic evaluations to construct an early health economic model. The results were compared with a health technology assessment (HTA)-ready model but **limited information about the approach was provided**.
- Findings: The study reported that the GPT-generated model effectively processed diverse data sources, producing early-stage economic assessments closely aligned with detailed, HTA-ready models. Additionally, critical cost-effectiveness variables were identified and highlighted potential evidence gaps. **No clear results were presented**.

CEM improvement and reporting

- Poirrier et al.[14] explored the use of Copilot for MS-Excel, specifically its use to **assist in developing Visual Basic for Applications** (VBA) code within a CEM. The researchers tested Copilot's ability to perform specific tasks, such as creating user interface (UI) interactions, **cost-effectiveness frontiers, and probabilistic sensitivity analysis (PSA)**, through general and step-by-step prompts.
- Findings: While Copilot successfully generated **simple UI-altering code and basic VBA tasks**, it struggled with more complex, health economics-specific requirements. Key findings indicated that **Copilot lacks context-specific knowledge** in health economics and requires highly detailed prompts to execute tasks accurately.

CONCLUSIONS

- Despite early promises, the integration of GenAI in cost-effectiveness modelling remains in its infancy and current efforts are focused on improving efficiencies in existing methodologies rather than exploring innovative modelling approaches.
- Challenges identified include the need for robust validation methods, transparency in model development, and adaptation to diverse healthcare settings. Ethical considerations regarding data privacy, algorithmic transparency, and stakeholder acceptance are also key challenges.
- Moving forward, concerted efforts are necessary to standardize methodologies, enhance reproducibility, and address regulatory concerns to realize the full potential of GenAI in improving the efficiency and accuracy of cost-effectiveness analyses in healthcare decision-making.

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DISCLOSURES

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