**Appendix**

**Appendix A.**

ChatGPT-4 was used to support the analysis of free text responses. The following prompts were used in April 2024:

* A survey asked surgical researchers "If you have, please describe how you used generative AI to help you to produce one or more surgical research outputs." The responses were as below. Please analyse and summarise the key emergent themes.
* A survey asked surgical researchers "What do you think are the opportunities that generative AI offers for surgical research?." The responses were as below. Please analyse and summarise the key emergent themes.
* A survey asked surgical researchers "What do you think are the risks of using generative AI offers for surgical research?" The responses were as below. Please analyse and summarise the key emergent themes.

**Appendix B.** Summary answers from survey results on Describe how you used generative AI to help you to produce one or more surgical research outputs’

From the survey responses provided by surgical researchers about their use of generative AI in producing surgical research outputs, several key themes emerge:

1. **Writing Assistance**:
   * Many researchers use AI for various writing tasks such as paraphrasing segments (for better language and diction), crafting introductions, and composing discussions. This assists in improving the clarity and professionalism of their texts.
   * AI is also used for rephrasing or editing English, especially helpful for non-native English speakers, and in helping to structure paragraphs and sections of research papers.
2. **Literature Review and Research Preparation**:
   * AI tools are frequently mentioned as aids in performing literature reviews by distilling papers, searching for relevant literature, and even suggesting related articles. This helps researchers manage the extensive amount of information available and focus on the most pertinent sources.
   * Researchers also utilize AI to conceptualize research, helping them to formulate research questions, refine research topics, and create research proposals.
3. **Statistical and Data Analysis**:
   * Some responses highlight the use of AI in statistical analysis and manipulating data (e.g., generating R code for data manipulation and graphing), although one researcher noted that using AI for deriving equations was not beneficial.
4. **Ethical and Regulatory Considerations**:
   * A few researchers expressed concerns about the clarity of rules and regulations regarding the use of AI in research publications. There is a recognition that many journals currently do not support the use of generative AI, but an expectation that this might change as guidelines evolve with the technology.
5. **Skeptical or Non-Use**:
   * A notable number of responses expressed that they have not used AI, with reasons ranging from lack of necessity, unfamiliarity, to skepticism about its appropriateness in medical science, particularly surgery.
6. **Potential for Future Use**:
   * Some researchers who have not yet used generative AI expressed a plan or interest in utilizing it in the future, particularly for tasks like literature reviews and manuscript preparation.

Overall, the responses indicate a growing interest and varied levels of adoption of generative AI in surgical research, primarily as a tool for writing support and literature management, but with significant room for expansion and development as the technology and guidelines evolve.

**Appendix C**. Summary answers from survey results on ‘What do you think are the opportunities that generative AI offers for surgical research?’

The survey responses on the opportunities that generative AI offers for surgical research highlight several key themes, reflecting optimism about the integration of AI technologies in the field:

1. **Enhanced Efficiency and Productivity**:
   * Many responses emphasize the potential for AI to significantly reduce the time required for various research tasks, including literature reviews, data analysis, and writing. AI is viewed as a tool that can streamline the research process, increase productivity, and assist in managing large volumes of data quickly.
2. **Advanced Training and Simulation**:
   * AI technologies, particularly in conjunction with virtual reality (VR) and augmented reality (AR), are highlighted for their potential to create realistic surgical simulations. This can provide trainee surgeons with risk-free environments to practice procedures and improve their skills, which is especially valuable in regions with fewer training opportunities.
3. **Precision and Personalized Medicine**:
   * Respondents note that AI can assist in creating personalized surgical plans by analyzing detailed patient data, such as medical images. This includes generating 3D models of organs or tumors and simulating surgical approaches, which can improve the precision of surgeries and potentially enhance patient outcomes.
4. **Robotic Surgery Enhancement**:
   * The integration of generative AI with robotic surgical systems is seen as a means to enhance the capabilities of surgical robots. AI can help in developing predictive models and adaptive control algorithms that increase the precision and safety of robotic-assisted surgeries.
5. **Data-Driven Insights and Predictive Analytics**:
   * There is a strong belief in the ability of AI to analyze vast datasets to identify patterns and insights that may not be apparent to human researchers. This can lead to advancements in surgical techniques and healthcare efficiency, as well as predictive analytics for patient outcomes and surgical risks.
6. **Improving Research Quality and Accessibility**:
   * AI is seen as a tool that can help improve the quality of research outputs through better grammar, structure, and even by suggesting references and creating high-quality figures. It also has the potential to make research more accessible to scholars from disadvantaged backgrounds by leveling the informational playing field.
7. **Risk Reduction and Safety in Surgery**:
   * Generative AI can contribute to safer surgical practices by providing real-time data and overlays during procedures, and by aiding in pre-operative planning and training without patient risk.
8. **Bias Reduction and Objective Analysis**:
   * Some responses highlight the potential for AI to reduce bias and increase objectivity in research analysis, assuming there is appropriate human oversight to ensure the accuracy and relevance of the AI-generated insights.

The overall sentiment from the survey is that generative AI holds significant potential to transform surgical research and practice by improving efficiency, enhancing training, personalizing patient care, and supporting high-quality, accessible research outcomes. However, careful implementation and oversight are necessary to ensure these benefits are realized without compromising the integrity or ethical standards of the research.

**Appendix D**. Summary answers from survey results on ‘What do you think are the risks of using generative AI offers for surgical research?’

The survey responses on the perceived risks of using generative AI in surgical research uncover several significant concerns across multiple areas:

1. **Bias and Data Integrity:**
   * A prevalent theme is the concern over bias in AI systems. Researchers worry that AI may reproduce existing biases present in the training data or generate biased outcomes due to limited and non-representative datasets. This could lead to inaccurate or misleading results, particularly in diverse patient populations.
   * Concerns about data integrity include the generation of false data or fictitious references, potentially leading researchers astray.
2. **Dependence and Skill Degradation:**
   * Many respondents express worry that reliance on AI could diminish researchers' skills. This includes the loss of critical thinking and analytical abilities, as AI tools might reduce the need for in-depth engagement with the research material.
   * There is also a fear of reduced originality in research, as AI may encourage a form of dependency where researchers lean heavily on generated outputs instead of developing original ideas.
3. **Ethical and Legal Concerns:**
   * Ethical issues are a major concern, particularly regarding the over-reliance on AI recommendations without sufficient real-world validation, which could compromise patient safety.
   * Legal concerns include potential medico-legal issues related to the use of AI-generated content, plagiarism, and the authenticity of AI-assisted research outputs.
4. **Privacy and Security Risks:**
   * The handling of sensitive patient data by AI systems raises significant concerns about data privacy and security.
   * Researchers are worried about data breaches and the unauthorized use of patient information, emphasizing the need for strict compliance with data protection regulations like GDPR or HIPAA.
5. **Quality of Research Outputs:**
   * There is a significant concern that AI could lead to a proliferation of low-quality research. This includes "junk research" characterized by plagiarism, lack of critical analysis, or mere regurgitation of known information without adding valuable insights.
   * The "black box" nature of AI, where the decision-making process is not transparent, complicates the validation and interpretation of results, potentially undermining trust in research findings.
6. **Technological Limitations and Misuse:**
   * AI’s potential for errors and the creation of "hallucinations" (i.e., generating incorrect or nonsensical information) were highlighted as risks that could mislead researchers or result in incorrect conclusions.
   * The misuse of AI, such as for generating misleading or fraudulent research, is a significant risk, especially if AI tools are used unscrupulously.
7. **Impact on Research Practice:**
   * There is concern about AI potentially fostering a culture of laziness among researchers, where ease of use leads to a reduction in rigorous scientific inquiry and creativity.
   * The impact on the learning and development of junior researchers is also noted, with AI potentially depriving them of the opportunity to gain experience through conventional research methodologies.

Overall, while recognizing the transformative potential of generative AI in surgical research, these responses highlight a range of risks that need careful management to ensure that the integration of AI into research practices enhances rather than undermines the quality and integrity of scientific inquiry.

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