

Course Title: Research Methodology in AI with Surgery

Course Code: AI800

Weighting: 20%

Lecturer: Dr. Mohammed Anbar

Hand-out Date: 15 mar 2025

Hand-in Date: 15 mar 2024

Hand-in Method: Online Submission via E-Learning

Assignment Report: Literature Review on AI in Healthcare and Surgery

Table of Contents:

- Summary of Research Papers
- Critical Analysis
- Connections
- Conflicts between Findings
- Synthesis Matrix for Literature Review
- References

Summary of Research Papers:

Paper 1:

Title: AI in Surgical Decision-Making: Personalized Treatment Plans

Authors: Choi, H., Kim, Y., Lee, S., et al.

Year: 2020

Objective:

This paper explores how AI is transforming surgical decision-making by analyzing patient data and creating individualized treatment plans. It investigates how AI can assist surgeons in making more accurate and informed decisions.

Method:

The authors conducted a literature review on AI applications in surgery, focusing on how AI processes various types of patient data, including medical images, genetic information, and medical history. They examined how AI can suggest personalized treatment plans by combining these datasets.

Strengths:

- The paper provides an in-depth analysis of how AI can handle large amounts of medical data and generate personalized surgical recommendations.
- It highlights how AI helps surgeons make data-driven decisions, improving patient outcomes.
- The study emphasizes AI's role in pre-surgical planning, such as anticipating potential complications and customizing procedures for individual patients.

Weaknesses:

- The study does not introduce new experimental data or clinical trials, relying solely on previous research.
- It does not address the practical challenges of integrating AI into everyday surgical practice, such as the need for specialized surgeon training or system integration with existing hospital infrastructure.

Key Takeaways:

AI has the potential to revolutionize surgical decision-making by analyzing complex patient data and providing personalized treatment plans. It enables surgeons to anticipate complications and make more precise, data-driven decisions, ultimately improving surgical precision, efficiency, and patient outcomes.

Paper 2:

Title: Ethical Implications of AI in Surgery: Job Displacement and Decision-Making Authority

Authors: Davis, D. A., Soderlund, A., & Taylor, S.

Year: 2020

Objective:

This study investigates the ethical implications of using AI in surgery, focusing on issues such as job displacement, decision-making authority, and patient data privacy.

Method:

The authors conducted an ethical analysis of AI's potential impact on surgery, examining existing literature and ethical frameworks. They evaluated the potential advantages and disadvantages of AI in surgical practices.

Strengths:

- The paper addresses ethical considerations, which are often overlooked in discussions about AI's technical capabilities.
- It raises important questions about the future role of surgeons and the extent to which AI might replace or complement human expertise.
- The study provides a comprehensive discussion of patient data privacy concerns and emphasizes the importance of establishing ethical frameworks to protect sensitive health information.

Weaknesses:

- The arguments are largely speculative, as there is limited evidence to suggest that AI will fully replace surgeons in the near future.
- The paper lacks real-world data or case studies to support its claims.

Key Takeaways:

AI is unlikely to completely replace human surgeons but will play an increasingly important role in assisting with surgical decision-making. The authors argue that AI should complement, rather than replace, human expertise, allowing surgeons to make more informed decisions while maintaining control over the surgical process.

Paper 3:

Title: Deep Learning for Skin Cancer Diagnosis

Authors: Esteva, A., Kuprel, B., Novoa, R. A., et al.

Year: 2017

Objective:

The study aimed to demonstrate that deep learning models can classify and diagnose skin cancer with accuracy comparable to that of experienced dermatologists.

Method:

The researchers developed a deep neural network to classify skin cancer images. The model was trained on a large dataset of over 130,000 clinical images, covering more than 2,000 skin conditions. They then compared the model's performance to the diagnostic accuracy of 21 board-certified dermatologists.

Strengths:

- The use of a large and diverse dataset enhances the model's ability to generalize across different types of skin cancer.
- The study provides strong empirical evidence that the AI model can match the diagnostic accuracy of human dermatologists.

Weaknesses:

- The study is limited to skin cancer diagnosis and does not explore the generalizability of the AI model to other medical conditions.
- It focuses solely on image-based diagnosis, ignoring other important diagnostic tools like patient history and physical examinations.

Key Takeaways:

The deep learning model achieved diagnostic accuracy on par with human dermatologists, showcasing AI's potential as a reliable and scalable tool for skin cancer diagnosis.

Paper 4:

Title: AI in Robotic Surgery: Current Applications and Future Prospects

Authors: Moustris, G. P., Nikolaidis, I., & Tsiknakis, M.

Year: 2014

Objective:

This paper explores how AI is currently being used in robotic surgery and what the future might hold. It focuses on how AI is making minimally invasive surgeries more precise and effective.

Method:

The authors reviewed the latest advancements in robotic surgery systems and examined how AI is being integrated into these systems to enhance surgical accuracy.

Strengths:

- The paper provides a comprehensive overview of how AI is currently being used in robotic surgery, particularly in improving precision and reducing invasiveness.
- It highlights the potential of AI to learn from past surgeries, enabling continuous improvement over time.

Weaknesses:

- The study does not thoroughly address the risks associated with increased reliance on AI in robotic surgery, such as technical failures or ethical concerns.
- It lacks real-world data or case studies to demonstrate the actual impact of AI on robotic surgeries in clinical practice.

Key Takeaways:

AI has significantly enhanced robotic surgery, enabling more precise and less invasive procedures. Systems like the da Vinci Surgical System, when combined with AI, provide surgeons with better control and visualization during complex surgeries.

Paper 5:

Title: AI in Healthcare: Enhancing the Human Touch

Author: Topol, E. J.

Year: 2019

Objective:

This book explores how AI can make healthcare more human by allowing doctors to focus more on their patients. Instead of replacing doctors, AI can handle routine, data-heavy tasks like diagnostics and paperwork, enabling healthcare professionals to dedicate more time to patient care.

Approach:

Topol builds his argument using real-world case studies, expert opinions, and future-focused insights. He examines various ways AI is already being used in healthcare, from improving diagnoses and personalizing treatments to monitoring patients more effectively.

Strengths:

- The book offers a hopeful and optimistic perspective on AI's role in healthcare, emphasizing its potential to enhance—not replace—the human side of medicine.
- It provides compelling examples and case studies that make the content accessible to readers without a technical background.

Weaknesses:

- Some of the ideas presented feel overly idealistic, as the book does not fully address the real-world challenges of implementing AI in healthcare, such as privacy concerns, technical reliability, and high costs.
- There is limited discussion on how to ensure that AI benefits everyone, particularly in underserved communities that may lack access to advanced technologies.

Key Takeaways:

AI has the potential to revolutionize healthcare by working alongside doctors, not replacing them. By handling time-consuming tasks, AI can improve diagnostic accuracy, personalize treatments, and enhance patient monitoring.

Paper 6:

Title: AI in Healthcare: Enhancing Patient Safety in Surgical Settings

Authors: Bates, D. W., Cohen, M., Leape, L. L., et al.

Year: 2019

Objective:

This study aims to explore how AI can help healthcare professionals improve patient safety, particularly in surgical settings. The goal is to develop AI tools that are both safe and effective, ultimately leading to better patient outcomes.

Method:

The authors reviewed existing research and case studies on AI in healthcare, with a particular focus on surgical safety. They examined how AI can support postoperative care, detect early signs of complications, and monitor patients' health to reduce risks and improve outcomes.

Strengths:

- The study's focus on patient safety is highly relevant and addresses a critical concern in healthcare.
- It provides a detailed discussion on how AI can identify and mitigate risks in real-world clinical settings, making it valuable for healthcare professionals and policymakers.

Weaknesses:

- The study relies heavily on theoretical discussions and literature reviews, lacking real-world data or practical experiments.
- It does not address important practical challenges, such as potential resistance from medical staff or the costs of implementing AI in healthcare systems.

Key Takeaways:

AI has the potential to significantly enhance patient safety by enabling early detection of complications, reducing human error, and improving monitoring during and after surgery.

Critical Analysis:

The papers reviewed offer valuable insights into the role of AI in healthcare and surgery, particularly in improving decision-making, patient outcomes, and safety. However, many of the studies rely on theoretical discussions or literature reviews, lacking real-world data or practical experiments. Future research should focus on validating these ideas through clinical trials and addressing practical challenges, such as staff resistance, implementation costs, and ethical concerns, to ensure the successful integration of AI in healthcare.

Connections:

Study	Authors	Year	Research Design	Key Findings/Results	Methodology	Limitations
AI in Surgical	Choi, H.,	2020	Literature	AI can analyze	Literature	No

1. **Focus on AI in Healthcare:** All the papers explore the application of AI in healthcare, particularly in improving decision-making, patient outcomes, and safety.
2. **Complementing Human Expertise:** Several studies, such as Davis et al. (2020) and Topol (2019), emphasize that AI should complement, rather than replace, human professionals.
3. **Patient Safety and Outcomes:** Many of the papers highlight the importance of AI in enhancing patient safety and outcomes, particularly in surgical settings.

Conflicts between Findings:

1. **Theoretical vs. Practical Focus:** While some studies, such as Esteva et al. (2017), provide empirical data to support their claims, others, like Bates et al. (2019), rely on theoretical discussions, which may limit their practical relevance.
2. **Ethical and Practical Challenges:** Some papers, such as Davis et al. (2020), address ethical and practical challenges, while others, like Topol (2019), present a more optimistic view without thoroughly exploring these issues.

Decision-Making: Personalized Treatment Plans	Kim, Y., Lee, S., et al.		Review	complex patient data to generate personalized surgical recommendations, improving decision-making and patient outcomes.	review focusing on AI applications in surgery.	experimental data or clinical trials. Does not address practical challenges of AI integration in surgery.
Ethical Implications of AI in Surgery: Job Displacement and Decision-Making Authority	Davis, D. A., Soderlund, A., & Taylor, S.	2020	Ethical Analysis	AI should complement human surgeons, not replace them. Ethical concerns include job displacement, decision-making authority, and patient data privacy.	Ethical analysis of existing literature and frameworks.	Arguments are speculative; lacks empirical data or case studies.
Deep Learning for Skin Cancer Diagnosis	Esteva, A., Kuprel, B., Novoa, R. A., et al.	2017	Experimental	The deep learning model achieved diagnostic accuracy comparable to human dermatologists, particularly in early-stage skin cancer detection.	Trained a deep neural network on 130,000+ clinical images and compared its performance to 21 dermatologists.	Limited to skin cancer diagnosis; does not explore other medical conditions or diagnostic tools beyond images.
AI in Robotic Surgery: Current Applications and Future Prospects	Moustris, G. P., Nikolaidis, I., & Tsiknakis, M.	2014	Literature Review	AI enhances precision and reduces invasiveness in robotic surgery. It aids in pre-surgery planning and outcome prediction, improving patient care.	Review of advancements in robotic surgery systems and AI integration.	Lacks real-world data or case studies. Does not thoroughly address risks or limitations of AI in surgery.
AI in Healthcare: Enhancing	Topol, E. J.	2019	Case Studies & Expert Opinions	AI can enhance healthcare by handling routine		Overly optimistic; lacks

the Human Touch				tasks, allowing doctors to focus on patient care. It improves diagnostics, personalizes treatments, and enhances patient monitoring.		discussion challenges like privacy costs, and scalability
AI in Healthcare: Enhancing Patient Safety in Surgical Settings	Bates, D. W., Cohen, M., Leape, L. L., et al.	2019	Literature Review	AI can enhance patient safety by enabling early detection of complications, reducing human error, and improving postoperative monitoring.		Relies on theoretical discussion lacks real-world data or practical experimen

References:

- **Bates, D. W., Cohen, M., Leape, L. L., et al. (2019).**
"Reducing harm from the use of artificial intelligence in healthcare: Approaches to ensuring patient safety."
Journal: Health Affairs, 38(8), 1-10.
Link: <https://www.healthaffairs.org/doi/full/10.1377/hlthaff.2019.00350>
- **Choi, H., Kim, Y., Lee, S., et al. (2020).**
"Artificial intelligence in surgical decision-making: A review of recent literature."
Journal: Journal of Healthcare Engineering, 2020, 1-12.
Link: <https://www.hindawi.com/journals/jhe/2020/9315265/>
- **Davis, D. A., Soderlund, A., & Taylor, S. (2020).**
"Ethical considerations of AI in surgery: Perspectives on its role and implications for medical practice."
Journal: Journal of Medical Ethics, 46(2), 1-7.
Link: <https://jme.bmj.com/content/46/2/1>
- **Esteva, A., Kuprel, B., Novoa, R. A., et al. (2017).**
"Dermatologist-level classification of skin cancer with deep neural networks."
Journal: Nature, 542(7639), 115-118.
Link: <https://www.nature.com/articles/nature21056>
- **Moustris, G. P., Nikolaidis, I., & Tsiknakis, M. (2014).**
"Artificial intelligence and robotic surgery: Present and future applications."
Journal: Journal of Robotic Surgery, 8(3), 1-6.
Link: <https://link.springer.com/article/10.1007/s11701-014-0486-x>

- **Topol, E. J. (2019).**
"Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again."
Book: Basic Books.
Link: <https://www.basicbooks.com/titles/eric-topol/deep-medicine/9781541644632/>

-