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Bridging the Gap Between Autopsy Findings and Healthcare Through Artificial Intelligence

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Abstract

The practice of medical autopsy is a well-established tool for establishing cause of death. As the gold standard for identifying pathology, autopsy is a vital educational resource to hone diagnostic skills at all levels of training. However, rates of autopsy have decreased by nearly 50% over the past 60 years. The evolving healthcare landscape requires continuous re-evaluation of how new technology can help apply autopsy findings to improve healthcare processes. The introduction of Artificial Intelligence in healthcare presents opportunities to apply autopsy findings in new and innovative ways. Artificial Intelligence integration into healthcare has gained considerable momentum, with a focus on addressing healthcare challenges such as diagnostic error. The capabilities of Artificial Intelligence in medicine are rapidly expanding, creating a transition in the delivery of healthcare. Autopsy findings can identify the types of pathologies that require Artificial Intelligence to augment decision making processes and mitigate errors. By enhancing pattern recognition and data analyses, Artificial Intelligence allows clinicians to focus on uniquely human aspects of medical care such as emotional intelligence and empathy. In these ways, Artificial Intelligence and clinicians can work together in symbiosis to mitigate the types of diagnostic errors identified by autopsy findings. We propose a call to action for increased autopsy rates and broader autopsy data application through artificial intelligence to refine diagnostic approaches and healthcare processes. Medical education must continuously adapt to understand the importance and role of autopsy findings in the era of Artificial Intelligence augmented healthcare. As new technology ushers in the era of personalized medicine, strengthening collaborations among clinicians, pathologists, and computer scientists will become increasingly pivotal to healthcare improvement.

Keywords: Autopsy; Diagnostic accuracy; Discordance rate; Healthcare; Diagnostic decision making; Artificial intelligence

Introduction

Diagnostic errors are not isolated to any single clinician, hospital, country, or continent. We have previously reported rates of discordance between premortem diagnoses and autopsy findings including 9.3% in India, 12.3% in Canada, 17.2% in the USA, 18.1% in the Netherlands, 19.0% in Greece, 25.6% in Spain, 28% in Brazil, and 48.4% in Jamaica [1]. Rates of diagnostic error have persisted despite advancements in laboratory testing and imaging studies. Test utilization is influenced by clinicians desire for certainty, aversion to risk, patient demands and medicolegal fears [2]. Unwarranted testing may lead to data pollution, over-diagnosis, and patient harm [3]. Despite widely published rates of pre- and post-mortem discordance, approximately 80% of physicians believe diagnostic error probabilities do not apply to their patients and rates of autopsy have continuously decreased by nearly 50% over the past 60 years [4,5]. Artificial Intelligence (AI) can be defined as the method by which computers mimic human processes and traits to complete tasks without the need for explicit programming [6]. The ever-growing demand for more precise healthcare delivery has led to the integration of AI, offering solutions to various data management and interpretation challenges. The introduction of AI into healthcare has presented

an opportunity to apply autopsy findings in new ways to improve rates of diagnostic error, test utilization and quality assurance processes.

Opinion

Pattern recognition is a fundamental component of clinical care. Modern healthcare has become incredibly complex and data-driven, requiring new strategies to identify patterns. Human cognition has limitations and would benefit from the implementation of new technology to augment diagnostic decision-making processes. The emergence of AI has significantly expanded our ability to identify and address patterns in healthcare. Autopsy findings identify the types of pathologies that require additional tools such as AI to augment decision making processes and mitigate diagnostic errors. Under time pressure, clinicians often rely on faced-paced pattern recognition to make diagnostic decisions, a process referred to as System 1 thinking [7]. In the past, System 1 thinking has been shown to be prone to framing bias, premature closure, and confirmation bias [8,9]. System 2 thinking involves a more reflective and analytic approach, often taking more time but resulting in fewer diagnostic errors [7]. By identifying and raising awareness of pathologies and circumstances that are most susceptible to error, autopsy findings can prompt a more reflective and analytic approach [10]. AI has been shown to recognize complex patterns to assist in System 1 thinking. AI systems can compile complete patient histories and identify potential risk factors, aiding clinicians in diagnostic decisions. AI can provide real time insights and trends to assist System 2 thinking processes. By providing capabilities in these areas of pattern, recognition and data analyses, AI can allow clinicians to focus on uniquely human aspects of medical care such as emotional intelligence and empathy [11]. AI and clinicians can work together in symbiosis to mitigate the diagnostic errors highlighted by autopsy findings.

Integrating AI into day-to-day medical practice represents the next step in healthcare evolution. AI's application in healthcare is most evident in diagnostic fields such as radiology, pathology, cardiology, and medical genetics. In radiology, AI can enhance workflow efficiency without compromising accuracy, addressing issues like fatigue and interpretation variability [12]. AI's applications extend to histological tumor identification. For instance, in tumor identification, AI has demonstrated the ability to efficiently analyze slides, often outperforming human clinicians [13]. In cardiology, AI systems facilitate the interpretation of auscultation data and electrocardiograms [14]. Genetic diagnoses are enhanced through AI, identifying over 200 syndromes from facial images [15]. In many disciplines, AI clinical decision support systems are diagnosing various conditions, often outperforming junior staff physicians [16].

Autopsy findings present an opportunity to evaluate the utilization of laboratory tests and diagnostic imaging. Proper application of laboratory tests is crucial for early diagnosis, aggressive treatments, and the use of costly tests and procedures. Our prior findings revealed that 54.8% of CT scans and 57.9% of MRI studies revealed previously undetected diagnoses [2]. Previous reports indicate that between 20-50% of imaging studies fail to contribute to patient care [17]. AI has shown the potential to inform best practices in the utilization of imaging modalities. AI is facilitating an increasingly proactive approach to healthcare. This shift towards preventive medicine is evident in conditions like leukemia, breast cancer, and heart disease. AI can model trends and uncover correlations in extensive datasets and is playing a growing role in understanding genomics, proteomics, and the nuances of long-term disease management. On an individual level, therapeutic choices can be guided by changes in the patient's unique biochemical markers, risk factors and lifestyles. Medication errors can be reduced by using AI to alert healthcare providers about adverse events and interactions. AI advances genomic understanding, allowing personalized treatments based on genetic factors. This shift has the potential to yield more accurate diagnoses, safer personalized treatments, quicker and more effective recoveries, and long-term cost savings. AI offers predictive analyses for aging processes and disease progression that can be tested against autopsy findings. At the population level, the combination of autopsy findings and AI technology can identify high-risk groups. This information guides the avoidance of risk factors and determines the optimal screening intervals for highly probable diseases. These tools enable prevention at the earliest stages and ensures the safest and most effective treatments are implemented. Quality assurance strategies have recognized the need to process large amounts of data to identify areas of focus to improve patient outcomes [18]. While prior efforts focused on overall diagnostic congruence and disparity rates, a shift to specificity and sensitivity as metrics for diagnostic accuracy has been proposed. Typically, these metrics are disease-specific, offering insights into certain pathologies without encompassing shared diagnostic factors across organ systems. To better understand clinical accuracy, sensitivity should be analyzed per case, instead of per disease. Applying this approach to five years' worth of autopsy data, our results suggest a 53.5% sensitivity across all pathologies and organ systems [19]. This approach quantifies clinical accuracy across diverse situations, providing an objective benchmark for clinical accuracy and creating an opportunity to identify underlying systemic error factors to improve patient care. This is an example of how autopsy findings and AI can work collaboratively to tackle complex issues such as the identification and disclosure of medical error through non-punitive and constructive methods.

Conclusion

Acknowledging the value of autopsy findings to healthcare system processes is the first step to increasing the rate and utilization of autopsy findings. For every 10% increase in autopsies that are performed, the rate of major medical errors decreases by 12.4% [1]. AI is reshaping our understanding of health and disease.

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As new technology ushers in the era of personalized medicine, strengthening collaborations among clinicians, pathologists, and computer scientists will become increasingly important. We put forth a call to action for increased autopsy rates and broader autopsy data application through artificial intelligence to refine diagnostic approaches and healthcare system processes. The evolving healthcare landscape requires continuous re-evaluation and adaptation of how new technology can help apply autopsy findings to improve healthcare processes. Medical education must continuously adapt to understand the importance and role of autopsy findings in the era of AI augmented healthcare. Effective use of AI demands innovative thinking, critical evaluation, and resource allocation for timely problem-solving, all processes traditionally informed by autopsy findings.

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