COMMENTARY

Artificial intelligence in healthcare: A call for strategic implementation to maximize impact and minimize costs

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ABSTRACT

Artificial Intelligence (AI) is transforming healthcare by improving diagnostics, decision-making, and patient outcomes. This commentary emphasizes the need for strategic AI implementation to maximize benefits while minimizing costs. Although AI can automate routine tasks and freeing clinicians to focus more on patient care, challenges like costs and medicolegal concerns must be addressed. A two-dimensional impact-effort framework is proposed to prioritize AI tools implementation based on their impact and costs.

KEYWORDS:
Artificial intelligence in healthcare, AI implementation strategy, Asplin conceptual model, medico-legal challenges, impact-effort matrix

INTRODUCTION

Artificial Intelligence (AI) was first conceptualized by John McCarthy in 1956 as an "electric brain," capable of executing tasks typically associated with human intelligence, including speech recognition, visual perception, learning, and decision-making.[1] A fundamental question in AI development has been: “Can a machine think?” This question was central to the work of Alan Turing, who in 1951 proposed a practical test for assessing machine intelligence, now popularly known as the Turing Test. According to Turing, a machine passes this test if a human, after asking a series of questions, cannot distinguish whether the responses come from a machine or from that of another human. To pass the Turing test, the machine must demonstrate three key capabilities: (1) understanding speech (natural language processing), (2) storing and recalling information (knowledge representation), and (3) using that information to reason, adapt, and learn (automated reasoning and machine learning).[1]

Indeed, the integration of AI into various fields has become so ubiquitous, that it is now likened as a “tsunami". Mustafa Suleyman, in his 2023 book The Coming Wave: Technology, Power, and the Twenty-first Century's Greatest Dilemma, vividly captures this phenomenon.[2] He describes a "wave" as the global diffusion or proliferation of this generation of new technologies that are of high demand across different industries at affordable cost.

In the field of medicine, the impact of this wave is particularly evident. Over the last decade, the number of publications on AI applications in healthcare has increased exponentially.[3] This surge reflects the growing recognition of the potentials of AI to revolutionize medical practice, from diagnostics and treatment planning to patient care and workflow optimization. To illustrate how AI implementation can be mapped strategically in a real-world clinical setting, a case study from emergency medicine is presented below.

CASE STUDY: THE IMPACT OF AI IN EMERGENCY MEDICINE

In emergency medicine for example, AI applications have shown promising results. A systematic review by Piliuk and Tomforde[4] categorizes AI applications into two broad categories, i.e., (1) diagnostics-specific and (2) triage-specific applications. Diagnostics-specific AI tool such as tools for predicting diseases like stroke, heart disease, and sepsis can enhance decision support by interpreting medical images and test results with greater accuracy and reliability. Triage-specific AI applications, on the other hand, focus on predicting patient outcomes, including mortality risk, which helps prioritize high-risk patients.

Given the wide array of AI tools available, systematically categorizing these tools to facilitate their integration into emergency department (ED) workflows is essential. One useful approach is perhaps the Asplin’s input-throughput-output conceptual model.[5] This framework categorizes ED processes into three stages: input, which addresses the demand for ED services; throughput, which involves the processes throughout a patient's stay in the ED; and output, which refers to the processes related to patient disposition, including admission, discharge, or continued care within the ED. Table I provides an example of mapping some AI applications according to the Asplin’s conceptual model.

REHUMANIZING HEALTHCARE WITH AI

One of the most intriguing aspects of AI in healthcare is its potential to rehumanize healthcare. This may seem paradoxical, given that AI is often perceived as a depersonalizing force. However, by automating routine tasks such as appointment scheduling and follow-up reminders, AI can free up time for more meaningful interactions with patients. Another example is the use of machine learning models known as the ambient AI scribes to transcribe clinical conversations in real time using speech-to-text technology.[6] These transcripts are then processed by large language models (LLMs) to generate structured summaries (such as the

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Table I: Some of the potential AI applications as described in previous studies[4,5] mapped according to Asplin's conceptual framework

Input	Throughput	Output
Prehospital Urgent Stroke Triage Score Using Machine Learning	Stroke alert at triage	ICU admission and in-hospital death of trauma patients
ROSC Identification for OHCA	Prediction of in-hospital cardiac arrest	Prediction of mortality following TBI
Triaging of undifferentiated patients	Classification of TBI into mild, moderate and severe according to GCS & metabolic stress profiles	Predicting the Need for Hospitalization for Pediatric Asthma Exacerbation
Shock decision during load distributing device mechanical CPR	Differentiating COPD from congestive heart failure	Neurological outcome at 90-day after ROSC in OHCA Prediction of need for hospitalization for urgent care patients
Prediction of out-of-hospital cardiac arrest	Detecting pneumothorax from ECG	Prediction of need for emergency neurosurgery within 24 h after moderate to severe TBI
Pre-hospital prediction of sepsis	Identification of anaphylaxis	
E-triage using machine learning	Early diagnosis of hypovolemic in trauma	
Prediction of neurological outcome following OHCA	Chest X-ray Interpretation	
Crash scene data to identify adults with moderate and severe vehicular injuries	Early recognition of signs of shock	

ICU = intensive care unit; ROSC = return of spontaneous circulation; OHCA = out-of-hospital cardiac arrest; TBI = traumatic brain injuries; CPR = cardiopulmonary resuscitation; COPD = chronic obstructive pulmonary disease; ECG = electrocardiogram

Table II: Examples of Challenges in AI Implementation and Applications in Healthcare[10]

Types of challenges	Examples in the Malaysian Context
P = policy	Lack of national strategies or clear regulatory direction for AI implementation in the Malaysian healthcare setting Absence of AI-specific legislation in the Malaysian healthcare setting
E = economic	Insufficient investment in infrastructure to support AI deployment
S = socio-cultural	Public mistrust and low awareness of AI capabilities and limitations
T = technological	Low technological awareness and literacy among the Malaysian public Lack of technological integration and interoperability in the healthcare system
E = environmental	Lack of AI ethics and governance expertise within the institutional review boards A lot of bureaucratic red tape slowing down innovation and AI trial approvals
L = legal	No dedicated legal framework for AI-specific liability and malpractice Unclear responsibility when AI-generated decisions lead to harm

commonly used “Subjective, Objective, Assessment, Plan”, or SOAP format).[7] In this regard, AI scribes can significantly ease the documentation burden for clinicians. By eliminating this burden, AI scribes enable clinicians to focus more fully on their patients and families in fostering a more compassionate and attentive human communication. Indeed, as Eric Topol[8], in his book *Deep Medicine: How Artificial Intelligence can Make Healthcare Human Again,* suggests, one of most significant contributions of AI tools to healthcare could in fact, be the gift of time, i.e., time that could be spent on patient engagement, education, understanding, and empathy. Topol quoted several past studies that have shown that even a slight increase in the time clinicians spend with patients can lead to better outcomes. For instance, by adding just one additional minute to a home visit, the risk of readmission could be reduced by 8%, and by spending more time with patients, hospitalization needs could be reduced by 20%.[8] Topol also referenced a report by the Institute for Public Policy Research titled “Better Health and Care for All” which suggests that should the potential of AI to automate healthcare processes can be fully realized, this could lead to productivity improvements valued at £12.5 billion annually, or approximately 9.9% of the NHS budget in England.[9]

STRATEGIC IMPLEMENTATION OF AI: THE IMPACT-EFFORT MATRIX APPROACH

Unfortunately, with the multitude of AI tools available, selecting the right ones for initial implementation can be daunting. In this regard, a practical approach to navigate through this maze is to evaluate each of these AI tools using a two-dimensional impact-effort matrix. In this regard, “impact” refers to the degree of automation that could be achieved, while “effort” could refer to the cost of implementation (Figure 1). By using this matrix, those tools that can yield a high degree of automation at a lower cost can be prioritized for implementation.

While this commentary uses the ED as a case study, similar systematic categorization of clinical flow processes may be adopted for other clinical specialties. For example, in surgical disciplines, AI applications could be categorized along the continuum of pre-operative, intra-operative, and post-operative phases. In primary care setting, alternative categorization may involve screening, diagnosis, treatment, and follow-up.

Although the potential of AI in healthcare is vast, its implementation and application face many challenges. The

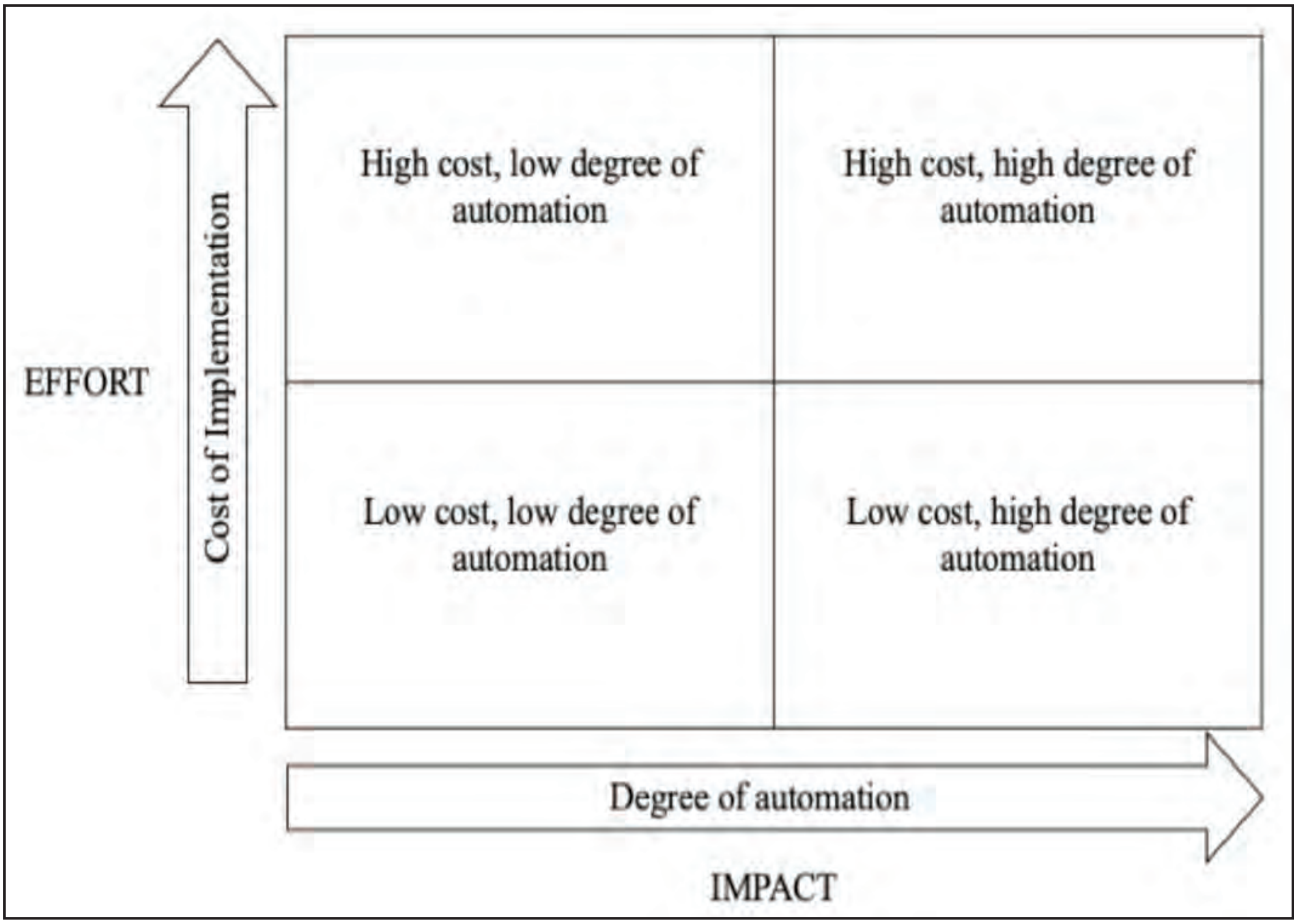

Fig. 1: Impact-Effort Matrix for AI Implementation in Clinical Practices

PESTEL framework, where P = Policy, E = Economic, S = Socio-cultural, T = Technological, E = Environmental, and L = Legal dimensions, offers a structured way to examine these challenges. Some specific examples of these challenges within the Malaysian context, mapped and adapted from Phang et al[10], are as outlined in Table II. Interestingly, Vearrier et al.[11] have highlighted another potential medico-legal concern in near future when AI tools become a standard clinical practice. Under the current Bolam test, clinicians may be held liable for not meeting the expected standard. But in near future, the use of these AI tools may redefine what constitutes acceptable care. As a result, the failure to adopt AI when it becomes the norm could be viewed as substandard care.

To support effective AI integration in healthcare, several policy actions are recommended. These include developing a national framework to guide ethical and legal standards, investing in infrastructure and digital training for healthcare staff, and establishing multidisciplinary regulatory bodies to oversee AI governance. Policymakers should also support pilot testing of AI tools in clinical settings to evaluate its impact and its cost of implementation, as well as to promote public engagement to build trust. These steps can help create a supportive environment for safe and meaningful AI adoption.

CONCLUSION

In conclusion, AI is poised to play an increasingly prominent role in healthcare, offering tools that can enhance diagnostic accuracy and optimize patient management. However, the successful integration of AI into clinical practices requires a careful balance between leveraging technology and preserving the human touch in patient care. The medico-legal landscape will similarly need to evolve in tandem with AI integration. As Hippocrates wisely observed, "It is more important to know what sort of person has a disease than to know what sort of disease a person has." AI has the potential to provide the additional time for clinicians to know the person with the disease rather than the disease of the person by automating processes to reduce wastages and inefficiencies. In the current setting of escalating healthcare cost, patient overload, and workforce burnout, AI offers a means to enhance patient-doctor communication and foster deeper and more meaningful engagement. By doing so, AI can fulfil its potential to make healthcare not only more efficient but also more humane again.

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REFERENCES

1. Howard J. Artificial intelligence: Implications for the future of work. Am J Ind Med 2019; 62(11): 917-26.
2. Suleyman M. The Coming Wave: Technology, Power, and the Twenty-first Century's Greatest Dilemma. London: Bodley Head; 2023.
3. Meskó B, Görög M. A short guide for medical professionals in the era of artificial intelligence. npj Digital Medicine 2020; 3(1): 126.
4. Piliuk K, Tomforde S. Artificial intelligence in emergency medicine. A systematic literature review. Int J Med Inform 2023; 180: 105274.
5. Asplin BR, Magid DJ, Rhodes KV, Solberg LI, Lurie N, Camargo CA, Jr. A conceptual model of emergency department crowding. Ann Emerg Med 2003; 42(2): 173-80.
6. Tierney AA, Gayre G, Hoberman B, Mattern B, Ballesca M, Kipnis P, et al. Ambient Artificial Intelligence Scribes to Alleviate the Burden of Clinical Documentation. NEJM Catalyst 2024; 5(3): CAT.23.0404.
7. Mess SA, Mackey AJ, Yarowsky DE. Artificial Intelligence Scribe and Large Language Model Technology in Healthcare Documentation: Advantages, Limitations, and Recommendations. Plastic and reconstructive surgery Global open 2025; 13(1): e6450.
8. Topol EJ. Deep Medicine: How Artificial Intelligence can Make Healthcare Human Again. New York: Basic Books; 2019.
9. Darzi A. Better health and care for all: A 10-point plan for the 2020s. 2018. Available from: https://www.ippr.org/articles/better-health-and-care-for-all.
10. Phang KC, Ng TC, Singh SKG, Voo TC, Alvis WA. Navigating Artificial Intelligence in Malaysian Healthcare: Research Developments, Ethical Dilemmas, and Governance Strategies. Asian Bioethics Review 2024.
11. Vearrier L, Derse AR, Basford JB, Larkin GL, Moskop JC. Artificial Intelligence in Emergency Medicine: Benefits, Risks, and Recommendations. J Emerg Med 2022; 62(4): 492-9.