Health, Health Systems and Advanced AI Solutions

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ABSTRACT
This paper presents aspects of the current status of AI in the health and healthcare services domain and suggests pathways for researchers and academics to contribute into this domain, and into health studies into the immediate future.

Keywords: unique sustainable advantage, competitiveness.

1. Introduction

Numerous health and healthcare services approaches are available today This presentation discusses (1) automated machine learning, (2) agentic AI, (3) inference time computing, (4) very large models, (5) very small models, (6) more advanced complex usage cases, (7) improved, optimized connectivities AI, (8) near infinite memory, (9) human in-loop augmentation, and (10) massive AI learning and processing powers (Abbaoui et al. 2024).

2. AI and Health Review

2.1. Automated Machine Learning

Automated machine learning is visually described as Figure 1. Here. health professionals can physically interact with multiple areas of the virtual world. They can delve into the inner aspects of the body and can jointly find potential problems and determine appropriate solutions. Thus, AI AML - is really AI and human augmented solutions are generating new health and healthcare solutions.

Figure 1. AI and Healthcare studies

2.1.1. AI-assisted robotic surgery

Today guided minimal invasive surgery is including robotic instrument operations to deliver multiple faster accurate surgery solutions for example ROBODOC is a surgery assistance device that is very useful in shavings down bone especially around hip sockets (Ficuciello et al. 2024). This approach often refines past operation AI data and sometimes frames new surgical techniques. Advantages can be assessed as 379 orthopedic patients delivering AI assisted outcomes that have around 20% fewer complications that those delivered by surgeons alone. Further with smaller incisions being needed (no internal hand space needed) hospital stays are reduced and healing time from incisions is reduced.

2.1.2. AI-assisted Robotic Surgery

Machine learning, its algorithms, its learning patterns across large, complex datasets can generate substantial improvements in neurosurgery (Buchlak et al. 2020). Similarly, other complicated operations involving organs such as heart, intestines, or stomach, also need special guidance as (1) the precise size and shape of each individual's organs differs somewhat, (2) the presence of scar tissue differs, (3) the exact placement of nerves and/or blood-vessels differs. Hence each operation is both specific and each patient is different. This necessitates AI devices with magnified, high-precision movements, and minimal incisions (less blood loss). Thus, AI assisted robotic surgery offers fewer potential complications. For example, the advanced Da Vinci surgical robot helps perform complex procedures with great control and less complications especially in oncology (cancer) treatment. In heart surgery some surgeons use Heartlander. This AI capable mini robot enters via small chest incision, and moves like a caterpillar tractor, it can map surfaces, do therapy across the surface of heart, or even insert a device.

2.1.3. Virtual Nursing Assistants

These robots are 24/7/365 capable. They can interact directly with a patient or support them into a best care setting. They can also answer questions, monitor patients, and provide quick answers. For example, Care Angel is an AI enabled robotic nurse that even provides wellness checks. Robotic or virtual nurses can readily replace healthcare personnel and can provide considerable cost savings for hospitals and nursing homes (Lundberg et al. 2022).

2.1.4. Aid Clinical Judgment or Diagnosis

AI can diagnose a patient's status. For example, Stanford University have an AI algorithm that detects skin cancers to the same level as a dermatologist's diagnosis. It has expanded this technology into a deep-learning program. In conjunction with an eavesdropping Danish AI software, it can even assess a human dispatcher's emergency calls by evaluating voice and background noise, voice tone etc. This software can even detect most cardiac arrests. Further, Baidu Research has a deep learning algorithm that outperforms humans when identifying breast cancer metastasis, and by AI delivering early predictions regarding a cancer, health professional can act early and prevent many cancer-related deaths (Wang et al. 2024). In addition, by 2033 AI algorithms will add medical records, habits, genetics, etc to their assessment processes. Yet another dimension of healthcare is facial dynamics – where face width, length of face, lip-length, ethnicity, race, and gender can further instantly pinpoint traits. or an individual's identity.

2.1.5. Workflow and Administrative Tasks

AI automated administration tasks in the USA offer $18 billion in savings as machine learning and AI helps doctors, nurses, and hospital personnel. Technologies like voice-to-text can speed operations and help order tests, prescribe medications, or even write chart notes. For example, IBM's Watson intelligent computer mines very big data and this helps physicians provide more efficient and more accurate patient treatment experiences (Gou et al. 2024).

2.1.6. Image Analysis

Image analysis is a very time-consuming and skilled assessment process. Recent MIT-led research has delivered an ML algorithm that in near-real-time analyses 3D scans around one thousand times faster that skilled radiologists. Thus, AI is helping to change the use of radiology scan analysis tools but not yet run the sampling processes. AI telemedicine extends medicine and image analysis into the home where video and/or VR phones can send pictures of rashes, cuts, bruises to the medical professional for diagnosis and maybe an AI assisted solution. AI Image analysis can even identify trends or genetic information that may predispose someone's predisposition to a particular disease, and so may save lives. AI assisted mental health diagnosis and/or treatment, elderly-care and/or assistance, robotic-diagnosis and/or operations, new genetics research, and disease solutions all bring new AI tools into today's mental health arena.

Thus, AI and automated machine learning (AML) can be transformative across multiple domains, not only for healthcare advancement, for the hospital (and its staff), for medical practitioners, and for each individual patient, for the elderly, or mental health patients.

2.2. Agentic AI

Today coded combinations of movements can work together to deliver complex solutions, or special functions, or unique actions, or correct responses. These are now deliverable from an intelligent robot, or with its assistance.

2.3. Inference Time Computing

This branch of AI delivers very-rapid, reasoned solutions. This involves real-time leveraging vastly more computations at the time of inference. This enlists enhanced AI reasoning capabilities and it extracts instant performance that also scans for new algorithmic insights by: (1) an access effect approach that aims to catch ups and move towards higher capabilities - typically by using available data and applying small model approaches, or (2) a research frontier approach where operators pursue potential and emerging benefits specifically connected towards delivering enhanced performance effects. This is displayed as Figure 2.

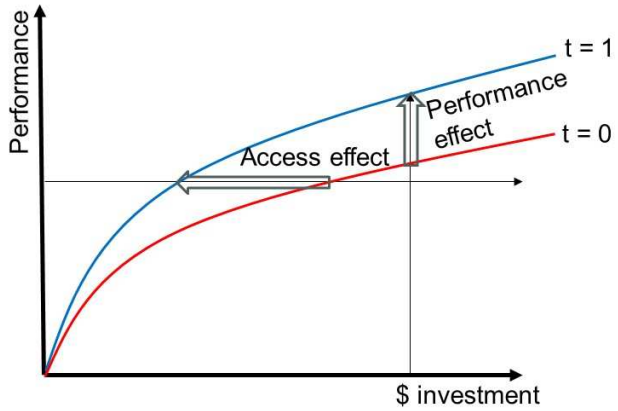

Figure 2. Relative performance over time

2.4. Very Large AI Models

These models enlist up to 50 trillion parameters in their real-time and same-time assessments. They pursue precision solutions across language, cryptology, body-language, musical-notation, chemical-signalling, symbols and/or charts, animal-communication, traffic-signalling, mathematical-equations, programming-languages, futures-decisions and/or processes, medical-decisions and/or actions. They do more than process text; they interact with various systems, and interfaces to perform tasks that involve actual actions, such as controlling robots or managing software (Abbaoui et al. 2024).

2.5. Very Small AI Models

These optimal precision-focused AI solutions typically assess around two billion known parameters. These drive small transformative and change advances in healthcare. For example, Multimorbidity or the co-occurrence of multiple chronic or acute conditions within a single individual could create a next pandemic. As people live longer, and chronic diseases grow in number, multimorbidity could emerge not through incidental accumulation of independent diseases, but instead as a single-organ injury that proceeded to incite damage in secondary organs through dysregulated inter-organ communication (Abbaoui et al. 2024).

New measurement technologies such as: spatial transcriptomics, proteomics, and metabolomics, plus multi-organ chip technologies and AI offer ways to advance understanding of homeostatic and disturbed inter-organ communication and so target, predict, and even prevent multimorbidity.

2.6. Complex AI Usage Applications

Complex AI usage applications apply in pharmacy-warehousing (Schneikart et al. 2024). Here, new capabilities and technologies actions operate instantly, 24/7/365. They can modify each storage bin's position, shape, size, height, and even stability against costs, speed, efficiency, hazards, product demand

mixes, etc. Thus, complex AI usage applications can deliver more efficient medical storage and retrieval systems.

2.7. Improved, Optimized Connectivities AI

Pervasive instant connectivities between stakeholders should co-exist and interconnect across multiple sensory (especially visual) and communications environments. For example, when a physician determines a patient requires medicine from pharmacy, the entire process should be AI assisted and rapid.

2.8. Near Infinite Memory

The healthcare system's memory needs to be all encompassing, and useful in enhancing assessment situations. Here, AI memory currently can store much more information than the human brain. Further, it is a memory system not affected by emotions or time, making it more reliable, and it can process and recall information much faster than humans too!

2.9. Human in-loop AI Augmentation

Humans are currently retaining a role in pervasive and useful agile activities. The current designs of AI systems fundamentally infuse technology and human interaction, in the pursuit of new tools for health, healthcare services, and other forms of human creativity.

2.10. Massive AI Learning and AI Processing Powers

Nvidia chip, network processing and memory exponential capabilities advancements are enabling large scale models to interplay – ones with more parameters that can adjust to learn from data. These more complex tasks are now approaching human intelligence and they are pushing boundaries in healthcare, finance, and beyond, handling things like medical image analysis, fraud detection, and even predicting patient outcomes.

3. AI and a Way to Research Analysis and Results

AI in healthcare is extremely complex (Abbaoui et al. 2024). Hence an approach for research is possible via a causal investigation – what exists now, what do we change, and what do we want to achieve. Such a causal investigation approach can generally be literature and theory based. Further, it can likely frame as a three stage Figure 3 deliverance model structure, but as the components likely intermesh and network, the research approach is likely best treated as a qualitative or quantitative modelling approach.

Figure 3. Qualitative or quantitative model for AI research

4. Discussion and Conclusion

Today the rapid advancement of AI into and across health, healthcare services and their periphery are leaving behind researchers and academics. Similarly, as AI continues to advance its medical practitioners, physicians, surgeons, nurses and professional are also being left behind in virtually all associated fields. However, AI is still only as good as quality of its collective global inputs. But AI is advancing towards generative AI (GAI) - where it can map its own solutions. Thus, all the health workforce, researchers and academics need to become competent in working with and interpreting AI - but how do they each keep up-to-date and contribute to this new dynamic?

5. Contributions to Research

This study contributes to the understanding of AI across healthcare and AI's progression towards GAI. The future of AI is pervasive, and it is now embedded into all areas. The controlling influence of humans across healthcare services is reducing as digital replacement capabilities continue to emerge and improve. AI instantaneous assessment capabilities are increasing. The time for treatment and recovery is reducing, robotic services are driving positive changes and healthcare in continually advancing towards better capabilities.

6. Limitations and Future Research

Although this study only sampled a small extent of healthcare domain, it shows aspects where, physicians, researchers, and academics each can contribute towards delivering a more generative AI capability. This study also suggests that an ongoing growth in human agility and action/reaction capabilities is necessary into the future.

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Authors' Backgrounds

Linda Forbes *was North Queensland Regional Manager for Education Queensland International. She now researches, and sometimes assists Dr Hamilton, on various projects concerned with AI and its advancement into the general fabric of society.*
Current Activities: *Clever Systems projects, Business and start-up intelligence developments, and smart solutions.*
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