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Human-Centric Artificial Intelligence and Robots in Healthcare

This article explores artificial intelligence and robotic solutions for human-centric healthcare resource allocation, addressing challenges like privacy and bias for equitable implementation.

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key points

- Artificial intelligence and robotics optimise healthcare resource allocation.
- Challenges include privacy, data security, and algorithmic bias.
- Collaboration is crucial for ethical implementation and patient acceptance.
- Despite challenges, these technologies can potentially improve care access and patient outcomes.

Introduction

In the complex ecosystem of healthcare management, decisions made at various levels can have profound implications for patient outcomes, resource utilisation, and overall efficiency of the system. From misallocation of resources to failure to coordinate patient care, the landscape is rife with challenges that can ultimately inhibit human-centric care. A human-centric approach in healthcare is one that focuses on the needs and perspectives of human beings, involving those offering and receiving the care. Fortunately, emerging technologies, particularly artificial intelligence (AI) and robots, are increasingly offering means of optimising healthcare management practices. As such, these technologies can be integrated through adequate application to avoid drastic resource allocation pitfalls. This article will discuss how virtual and physically embodied AI technologies can be applied in healthcare scenarios to offer human-centric care through effective resource allocation. Moreover, the article will outline some challenges that may arise while applying robots and AI in healthcare.

Virtual AI Applications

Virtual AI applications refer to software systems that use artificial intelligence to perform tasks and interact with users virtually, often via chatbots, virtual assistants, or automated systems. In contrast to robots, virtual AI applications do not have a three-dimensional physical presence.

One of the main areas where AI can address resource allocation problems is predictive analytics and demand forecasting. By analysing large amounts of data, including patient demographics, historical utilisation patterns and epidemiological trends, AI-powered algorithms can generate accurate predictions of future healthcare demands. These insights enable healthcare

organisations to proactively allocate resources such as staff, equipment and supplies based on anticipated needs, thus minimising underutilisation or overcapacity. For example, some diagnostics companies have implemented AI-driven solutions to forecast demand for medical diagnostics tests, such as blood tests and genetic screenings. By leveraging machine learning algorithms, these companies can analyse vast amounts of data from healthcare facilities and historical trends to predict future testing needs accurately. This helps them optimise inventory management, ensure timely supply chain operations, and ultimately improve patient care.

In addition, AI-based predictive models can identify areas of inefficient resource utilisation, allowing healthcare managers to reallocate resources strategically. For example, AI algorithms can analyse patient flow patterns within a hospital, identify bottlenecks in the care delivery process and suggest optimisations to improve throughput and reduce waiting times. By reallocating resources to areas of greatest demand or need, healthcare organisations can improve access to care and enhance patient satisfaction. From an employee perspective, this also includes staffing schedules that account for a fair workload distribution that considers adequate rest times for healthcare workers. Overall, optimising the forecasting of patient demand staffing schedules presents a reduction of wasted resources (e.g. sitting around) while improving the overall service experience of the patient. Moreover, healthcare professionals will feel less pressure due to staffing shortages, resulting in fewer errors and risk of burnout.

It should be noted that the aforementioned applications rely mainly on AI systems that can run virtually to offer optimised resource allocation in combination with human staff. However, such optimisation efforts should also consider the integration of physical robots that can directly act and participate in tasks in the three-dimensional realm.

AI-based predictive models can identify areas of inefficient resource utilisation, allowing healthcare managers to strategically reallocate resources

Physical Embodied Robots

Physical robots also play a crucial role in optimising resource allocation in healthcare. Robots with AI capabilities can perform repetitive and time-consuming tasks with precision and efficiency, freeing human resources for more complex and value-added activities. For instance, some healthcare providers have already implemented robotic inventory management systems. Such systems use robots to automate the storage, retrieval, and dispensing of medications and supplies in hospital pharmacies, thus improving efficiency and accuracy while reducing labour costs. Ensuring that medical supplies are properly stocked decreases the likelihood of shortages or excess inventory. This automated approach improves resource utilisation and minimises the risk of errors associated with manual inventory management practices.

Moreover, robots are increasingly being used in patient care settings to augment the workforce and alleviate staff shortages. For example, robots can assist with activities of daily living for elderly or disabled patients, such as lifting patients in and out of bed or the bath. Such applications can consequently reduce the physical strain of nursing staff. In addition, robots can provide medication reminders and facilitate remote monitoring of vital signs. Further, although human interaction should be prioritised whenever possible to offer social support, staff-to-patient ratios are often less than ideal, and robots can assist in overcoming these bottlenecks. Indeed, research shows that close interaction with social robots (i.e. those that can communicate with humans) is a fruitful avenue to reduce patients' loneliness and depression. Overall, by supplementing the workforce with robots, healthcare organisations can improve the quality of care, improve patient outcomes, and optimise resource utilisation.

Challenges

Despite these automation-enabled advantages, healthcare organisations must address several challenges to realise the full potential of AI and robots in rectifying resource allocation bottlenecks. First, privacy and data security concerns must be addressed to ensure the confidentiality and integrity of

patient information used by AI algorithms. Companies must ensure that data collection and use are in line with customers' expectations and preferences. Second, companies should be transparent about how they use customer data and provide customers with control over their personal information. This may include the ability to access, modify or delete their data at any time and the option to opt out of certain data collection practices. Third, efforts to mitigate algorithmic bias and ensure equity in decision-making are essential to avoid disparities in resource allocation and access to care. For instance, there are reports indicating that due to algorithmic bias, patients of particular ethnic groups had to be considered much sicker than patients belonging to another ethnic group to be recommended for the same care. This bias was due to the use of AI training data based on previous healthcare spending data due to long-standing wealth and income disparities. Therefore, it is essential that AI models and the training data are constantly monitored to offer non-discriminatory services. Otherwise, despite the initially seemingly resource allocation benefits, investment into such technologies may be unacceptable from an ethical perspective.

To overcome these challenges, collaboration between clinicians, administrators, data scientists, and technologists is essential to designing and implementing AI-powered solutions that align with organisational goals and ethical practices. Decision-makers should consider the patient, who will ultimately interact with the technology. Not all patients have the same technological skills and display high degrees of technology acceptance, particularly when it comes to a delicate topic such as their health. Hence, optional usage of more traditional versus novel technologies and care approaches should be offered during the first integration stages. Gradual integration will enable managers to improve technology acceptance among patients, thus assuring a more long-term benefit in terms of their allocated resources. Similarly, beyond patients, the impact on healthcare professionals needs to be accounted for. The integration of these technologies entails that healthcare professionals will suddenly have a new "artificial co-worker", which can disrupt their current practices. Thus, it is important to educate the affected healthcare professionals about how integrating these technologies may impact and benefit them.

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Conclusion

Finally, if managed adequately, AI and robots have immense potential to rectify healthcare resource allocation problems by harnessing predictive analytics, robotic automation and augmented workforce capabilities. Despite the potential challenges, by harnessing the power of these technologies, healthcare organisations can optimise resource utilisation, improve access to care, and ultimately improve patient outcomes in an increasingly complex and dynamic healthcare landscape.

Conflict of Interest

None.