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## **THE FUTURE OF REMOTE HEALTHCARE**

**Which technology do you believe will be most beneficial in reshape the capability to care for patients remotely and from home?**

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Abstract:

This report investigates the rise of AI systems in the healthcare industry and draws comparisons between AI machine learning programs and more traditional forms of telemedicine (specialized physician treating the patient live) to treat patients remotely. It documents and explains recent studies and data to evaluate the methods of remote treatment on a multifaceted level and their resonance in the current medical landscape. Furthermore, this report extensively analyses the paramount factors of successful remote treatment through primary and secondary research yet argues in favour telemedicine.

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## Introduction:

The global AI healthcare market, valued at \$11 billion in 2021, is projected to experience exponential growth, reaching approximately \$188 billion by the end of this decade, with a staggering compound annual growth rate (CAGR) of 37% (Stewart, 2023). This significant surge is attributed to the increasing adoption of AI technologies across various healthcare domains, from diagnostics and clinical research to patient care and remote treatment. Despite AI's transformative potential, recent clinical studies highlight a growing concern among patients, particularly regarding the use of AI-powered chatbots in both in-clinic and remote medical treatments (Tyson & Pasquini, 2022). The discomfort reported by patients often stems from their unfamiliarity with these technologies, which were rapidly integrated into healthcare settings due to the COVID-19 pandemic. This sudden shift resulted in a heightened reliance on traditional technologies like telemedicine, which many patients found more accessible and comforting. For example, during the pandemic, telemedicine services became indispensable in the United States, with companies like Teladoc gaining prominence. In the UK, the adoption of remote consultation platforms saw a dramatic rise, with 99% of NHS GP practices incorporating these services into their healthcare models (Patel, 2020).

The ongoing debate surrounding the comparative effectiveness of fully automated AI technology versus human-dependent technologies, like telemedicine, in remote patient treatment continues to grow. On the one hand, AI offers unparalleled analytical capabilities, with the potential to process vast amounts of medical data in real-time, providing precise diagnoses and treatment recommendations that can often surpass human abilities. AI systems, particularly those designed for specialized tasks like image analysis or predictive modeling, have demonstrated remarkable accuracy and efficiency, streamlining complex medical processes and reducing human error.

On the other hand, human-dependent technologies, such as telemedicine, are rooted in the cognitive skills, experience, and empathy that healthcare professionals bring to patient care. Many patients value the human element in their healthcare experience, particularly when it comes to emotional support, trust, and shared decision-making. Physicians can offer personalized care and adapt to the nuances of a patient's condition in ways that AI systems currently cannot replicate. Additionally, telemedicine provides an accessible platform for real-time interaction between patients and physicians, fostering a sense of continuity and trust in the patient-provider relationship.

The critical question this report seeks to address is whether AI or human-dependent technologies offer a more comprehensive and cost-effective solution for remote patient treatment. To answer this, the report will analyze several key factors, including the advantages and limitations of both technologies, public perception, cost-effectiveness, and the feasibility of widespread implementation. It will explore how AI's powerful computational abilities can complement or even enhance human-centered care, while also acknowledging the limitations that come with automating healthcare services, particularly in terms of patient comfort and the need for human empathy. Furthermore, it will assess the economic viability of scaling AI systems in comparison to telemedicine platforms, which have already been widely adopted in healthcare systems around the world.

Ultimately, this analysis aims to provide a well-rounded evaluation of both AI and human-dependent technologies in the context of remote patient care, offering insights into which approach may deliver a more effective, accessible, and sustainable healthcare experience for patients globally.

‘AI is perhaps the most transformational technology of our time, and healthcare is perhaps AI’s most pressing application.’ - Satya Nadella, chief executive officer, Microsoft.

## AI technologies – Medical Chatbots

Experts anticipate transformative AI-driven advancements in healthcare, particularly in chronic disease management, diagnostics, and clinical decision-making. While still in the early stages of widespread adoption, AI algorithms have already demonstrated immense potential in specialized medical areas, such as radiology, pathology, ophthalmology, and cardiology (Beam & Drazen, 2023). These sophisticated algorithms continue to refine their precision and accuracy by interacting with vast amounts of training data, offering increasingly reliable insights into diagnostics, treatment options, and remote patient care outcomes (Krittanawong, 2018). As AI systems evolve, their capacity to process complex healthcare data—such as medical imaging, patient histories, and genomic information—has proven invaluable in facilitating highly accurate diagnoses and personalized treatment plans. AI’s potential to interpret vast amounts of data quickly and accurately positions it as a game-changer in modern healthcare, offering tools to aid physicians in delivering better patient outcomes.

A notable example of AI’s integration into healthcare is the Bayesian AI system, developed at the Institute of Biomedical Engineering at Oxford University. This system is designed to enhance diagnostic precision and is already integrated into the UK National Health Service (NHS). Plans are in place to deploy this technology in low- and middle-income countries (LMICs) to improve remote healthcare accessibility and bridge the healthcare gap in underserved regions (Ghosheh, Thwaites, & Zhu, 2023). These systems are critical in helping healthcare providers reach patients in remote or resource-poor areas where medical specialists may not be readily available, potentially revolutionizing the global healthcare landscape. AI’s ability to support remote healthcare delivery is seen as one of its most promising applications, particularly as telemedicine grows in prominence across the globe.

Despite these promising developments, AI in healthcare faces substantial challenges, both in terms of technological capabilities and public acceptance. While AI excels in data analysis, pattern recognition, and decision support, it lacks the essential human qualities of empathy and reassurance, which are critical in healthcare settings. In fields like mental health, where

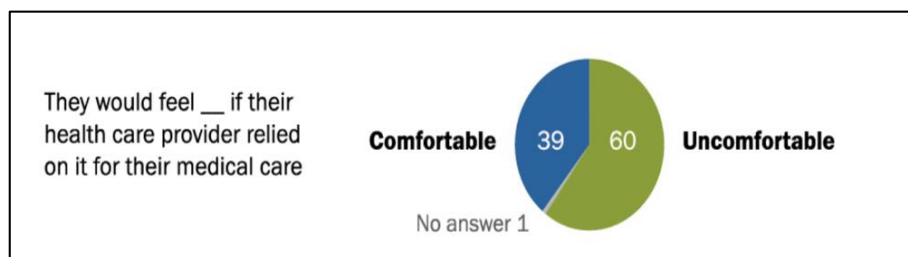


Figure 1 – Survey conducted : Dec 12-18 2022

Source: PEW RESEARCH CENTRE

emotional support and trust between patients and healthcare providers are vital, AI systems currently fall short of replicating the nuanced and compassionate care that only a human can

provide (Farhud & Zokaei, 2021). This limitation is echoed in the broader medical field, where the stakes of life and death differentiate healthcare from other industries reliant on AI. According to recent research, “healthcare is different because patient lives are on the line. The stakes are higher in medical AI than in other kinds of AI” (Beam, 2023). This underscores a core concern: while AI can assist in clinical decision-making, patients and healthcare providers alike are cautious about entrusting critical decisions entirely to machines.

Public apprehension about AI in healthcare is further supported by data from a recent study involving 12,004 adults in the United States. The study revealed that 6 in 10 adults expressed discomfort with the idea of their healthcare providers relying heavily on AI for diagnosis or treatment recommendations. This discomfort stems from a combination of factors, including the lack of transparency in AI decision-making processes and the fear that reliance on AI may lead to depersonalized care (Capoot, 2023). Such findings highlight the need for careful integration of AI into healthcare settings, ensuring that AI acts as a supportive tool rather than a replacement for human judgment.

Additionally, there are significant cost-related challenges associated with developing and implementing AI technologies in healthcare. AI systems, especially those capable of handling sophisticated tasks like digital pathology, require extensive infrastructure, including vast amounts of storage and processing power. For instance, the AI system developed by Microsoft in collaboration with Paige for digital pathology, which is capable of detecting irregularities in patient-submitted photos, requires over a gigabyte of storage per digitized image. This level of data storage presents substantial infrastructure and cost obstacles, especially for national healthcare systems that aim to scale AI implementation (Capoot, 2023). Andy More, the CEO of Paige, voiced concerns regarding the feasibility of widespread adoption due to these high costs, noting that healthcare systems must balance the potential benefits of AI with the financial implications of large-scale integration.

For national healthcare services such as the NHS, the economic feasibility of AI adoption is a crucial consideration. With healthcare systems already stretched thin due to workforce shortages, aging populations, and rising costs, funding allocations for AI implementation must be made with caution. Advanced AI systems, while promising, are expensive to develop and maintain, which complicates their immediate feasibility, particularly in remote patient care. Enabling doctors to conduct remote physical symptom analysis via AI-driven systems in telemedicine contexts—such as live video consultations—remains a distant reality, given the current technological and financial barriers.

Moreover, the high cost of mature AI systems limits their accessibility to smaller clinics and resource-limited healthcare providers, further widening the gap between well-funded institutions and those struggling to meet basic healthcare demands. This discrepancy is particularly relevant for LMICs, where healthcare systems may lack the infrastructure required to integrate AI technologies effectively, despite their potential to improve patient outcomes. As a result, AI-driven healthcare remains concentrated in wealthier nations and high-tech institutions, raising concerns about the equitable distribution of AI benefits across the global healthcare landscape.

## Human Dependent Technologies - Telemedicine:

Telemedicine, defined as virtual patient-physician meetings conducted via telecommunications platforms like video calls, has significantly gained prominence since the onset of the COVID-19 pandemic. Prior to the pandemic, telemedicine existed as a supplementary healthcare tool, often used in rural or remote regions where access to in-person medical services was limited. However, the global health crisis catalyzed its widespread adoption across healthcare systems worldwide, as it provided a safe, convenient, and effective method of maintaining healthcare delivery while minimizing physical contact. The demand for telemedicine grew exponentially as healthcare providers needed to balance patient care with social distancing requirements. As the healthcare industry continues to evolve to meet the demands of a fast-paced, digital society, telemedicine has emerged as one of the most promising human-dependent technologies, allowing for the delivery of medical care without the constraints of geography or in-person appointments.

One of the key reasons for telemedicine's success is its preservation of the human element in healthcare, offering patients the comfort of interacting directly with physicians, even in a remote setting. Unlike fully automated AI systems that may lack the empathy and personalized attention patients often desire, telemedicine facilitates a virtual face-to-face interaction that retains the core aspects of human-dependent care. This personal connection between physician and patient is essential for building trust, ensuring accurate diagnosis through real-time communication, and fostering a sense of reassurance, especially in cases where patients may feel anxious or unsure about their health concerns.

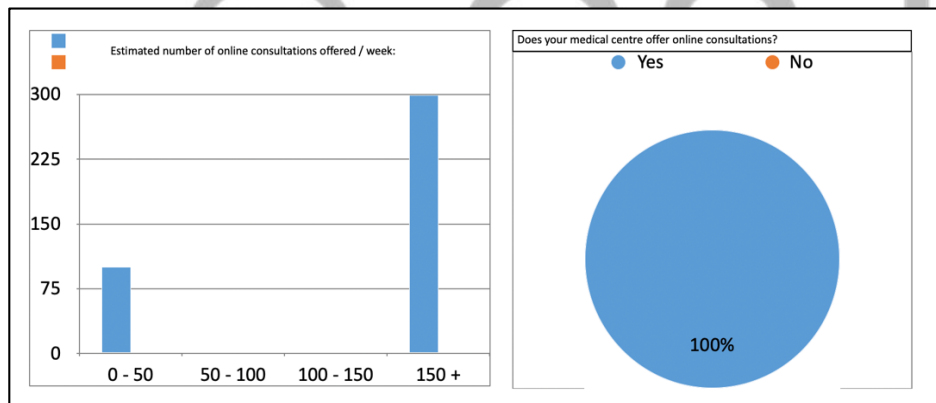


Figure 2 & Figure 3 – Survey conducted Sept 16 – 23.  
Unpublished survey.

As highlighted

in Figure 2, a survey I conducted with the cooperation of doctors from four different countries revealed the widespread use of online consultations in modern medical practice. The survey results indicated that 75% of respondents estimated their medical centers were conducting over 150 online consultations per week. This widespread adoption reflects the growing reliance on telemedicine as an integral part of the healthcare delivery system, allowing physicians to reach a larger patient base without being constrained by the physical limitations of in-person visits. These virtual consultations not only ensure that patients receive timely medical advice but also streamline the efficiency of healthcare services by enabling doctors to manage their schedules more effectively.

During an interview with Dr. Faraz Anjum, a practicing NHS physician, he underscored the economic advantages of telemedicine, stating, “Telemedicine is definitely more economically feasible for both the doctor and the patient. Most working adults in the UK prefer the convenience of a call and appreciate the time saved. Online consultations are indispensable to the NHS.” Dr. Anjum’s remarks highlight two significant benefits of telemedicine: convenience and cost-efficiency. For patients, particularly working professionals, the ability to consult with a doctor from the comfort of their home or office eliminates the need for travel, time off work, or extended wait times in clinics. For doctors, telemedicine offers a flexible way to manage appointments, which allows them to optimize their time and treat more patients in a given period. These advantages make telemedicine an attractive option not only for healthcare providers but also for patients seeking a more accessible and streamlined healthcare experience.

The economic feasibility of telemedicine is further supported by data from various studies, which suggest that telemedicine can lead to significant cost savings for healthcare providers. A time-series analysis of data from January 2013 to March 2018 conducted by Moss and Bracewell (2023) demonstrated that the implementation of telecare services in clinics resulted in immediate cost savings of £74 per week, with a further decrease of 9p per subsequent week. These findings underscore the financial viability of telemedicine as a long-term healthcare solution, as it allows healthcare providers to reduce operational costs while simultaneously increasing their capacity to treat more patients. The ability to deliver care remotely also minimizes the need for physical infrastructure, such as waiting rooms and exam spaces, thus lowering overhead costs for medical centers.

Moreover, telemedicine has emerged as a vital tool in addressing workforce shortages in national healthcare systems, a challenge that has been exacerbated in recent years. Many countries, including the UK, are experiencing a shortage of healthcare workers, particularly doctors. According to a report by Morgan (2022), the NHS reported a vacancy rate of 9% among doctors, indicating a significant gap in the availability of qualified medical professionals. This shortage places immense pressure on the healthcare system, leading to longer wait times for patients and increased workloads for existing staff. Technologies such as telemedicine can play a crucial role in mitigating these challenges by optimizing physicians’ time and resources. By allowing doctors to conduct routine consultations remotely, telemedicine frees up in-person appointments for more urgent or complex cases, helping to keep hospitals and clinics available for emergencies and critical care.

## **Conclusion:**

The integration of both artificial intelligence (AI) and human-dependent technologies in remote patient treatments marks a profound shift in the healthcare industry, promising significant advancements and improvements in service delivery. Both these technological approaches bring distinct advantages that include increased convenience, cost-efficiency, and an overall enhancement of patient care quality. As of now, AI systems utilized in remote healthcare services are still in their early stages of development, with many being relatively basic compared to their full potential. However, AI has already proven its effectiveness in specialized areas of medicine, particularly in clinical research and diagnostics, where its powerful analytical capabilities have become invaluable. Notable examples include AI’s role in the development of Moderna’s COVID-19 vaccine, where its ability to rapidly analyze vast datasets was key, and its application in detecting malignant tumors from medical images, showcasing its precision in life-saving early diagnoses. These highly specialized uses require AI’s advanced computational prowess, which surpasses human abilities in speed and accuracy. However, when it comes to general remote patient treatment, the demands are different, and such high-level AI capabilities are not yet essential. Therefore, in the current

landscape, “human-dependent technologies like telemedicine demonstrate greater effectiveness in addressing the needs of remote patients,” as noted by Dr. Anjum.

Telemedicine provides a direct, reliable, and human-centered approach that is more adaptable to the nuances of patient care, especially in rural or underserved regions. Despite this, the rapid development and integration of AI systems in the healthcare sector indicate a potential transformation of remote patient treatment in the near future. In summary, while there is tremendous potential for AI to revolutionize remote patient care, the number of AI systems that have received regulatory approval and undergone extensive testing is still quite limited. The current AI models and healthcare chatbots lack the advanced functionalities necessary to reshape the remote healthcare sector entirely. Nonetheless, with the pace at which AI technologies are evolving, it is highly likely that the landscape of remote healthcare will be significantly influenced by AI in the coming years, paving the way for more sophisticated, automated, and efficient systems to improve patient outcomes on a global scale.

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