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Original article

Human-Machine Interface for Digitization in Healthcare

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Abstract: *The healthcare sector is shifting. The demand for healthcare services is gradually growing, the number of patients opting for remote care is surging, and the recruitment of specialists is increasingly becoming challenging. These changes make relying on traditional healthcare delivery methods such as in-person care nearly impossible. HMIs provide novel approaches for providers to address emerging challenges in the sector. The technologies facilitate the delivery of services to many patients, even with limited staff, allow the delivery of care services virtually, and enhance the overall quality of service delivery. This piece of writing discusses HMIs in healthcare and their impact.*

Index Terms*: Human-Machine Interfaces, HMIS, Healthcare, Technology.*

I. INTRODUCTION

The Human-Machine Interface (HMI) industry has experienced significant evolution from a simple push button to modern touchscreen displays. Unlike in the past when operators could only operate machines by toggling buttons, modern users can execute complex machine operations using multifaceted controls on touchscreen displays. Although HMI technologies are largely leveraged in the industrial sector, recent developments in the healthcare sector have necessitated implementing the technology in facilities.

II. MODERN HEALTHCARE NEEDS

Typically, healthcare services are delivered in person by healthcare givers. Patients visit healthcare facilities for treatments, or healthcare givers attend to their patients in their homes. Although in-person caregiving is still widely practiced, recent developments in the healthcare sector have rendered sole reliance on in-person care untenable. Some of the emerging trends limiting reliance on in-person care delivery are;

A. Increasing demand for healthcare services

The global population is increasing. According to the United Nation, the global population reached 8 billion in 2022 and is expected to hit 9.7 billion by 2050 [1]. As the population increases, the demand for healthcare services also grows. With surging care demand, serving all patients in person is becoming unfeasible.

B. Recruitment challenges

To meet the growing demand for healthcare services, providers are investing in expanding their headcount. This has led to increased competition for medical experts in the labor market. Besides increased competition in the job market, there is an undersupply of some talents. For example, the global supply of neurosurgeons is extremely low, impelling healthcare providers to share these experts. Talent bottlenecks are making it challenging for providers to consistently provide in-person care.

C. Need for remote care

In the commercial sector, modern consumers prefer shopping in the comfort of their phones and having products delivered to their doorstep. This is also a growing trend in the healthcare sector. Modern patients, especially those with minor illnesses or chronic conditions, prefer limiting physical visits by getting medical assistance remotely on their digital devices.

D. Personalized care

Healthcare providers are shifting from a one-size-fits-all model to personalized care that corresponds to patients' actual needs and preferences. Personalized care puts the patient at the center of the treatment process. Rather than care providers doing everything, patients may be required to complete some processes with guidance delivered digitally. Also, personalized care leverages big data that is only useful when processed timely, something humans cannot do manually. The need for personalized care limits in-person care.

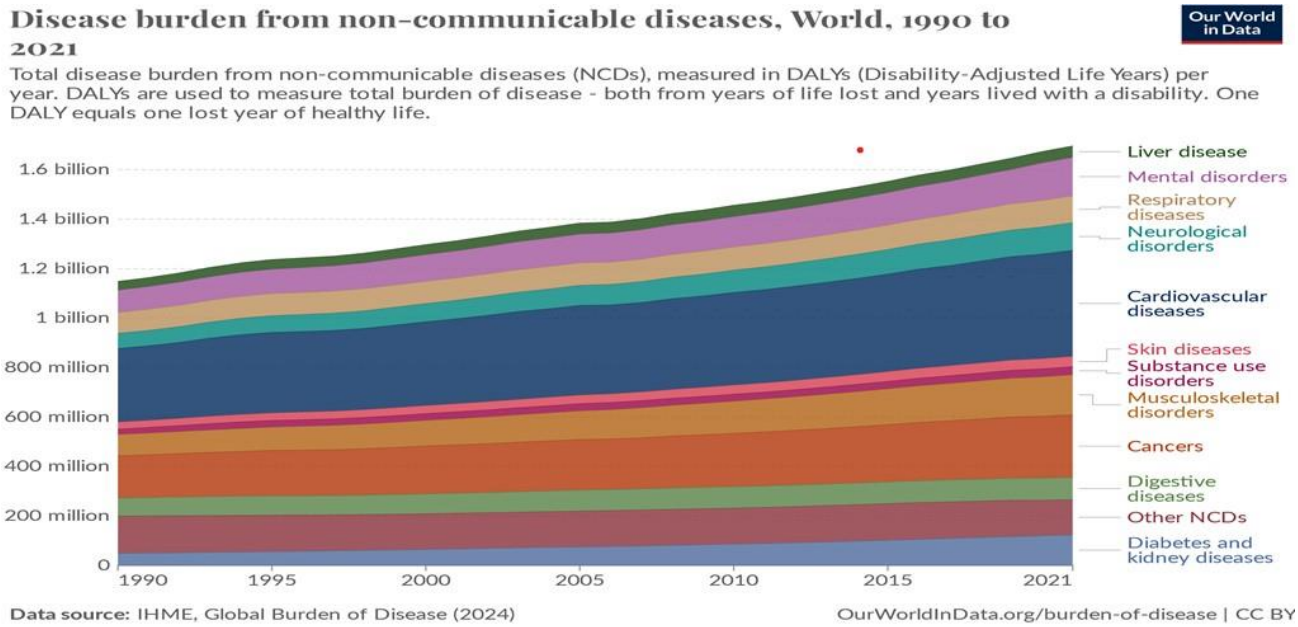

Figure 1: Growing Number of Disease Burden Indicating Growth in Care Services Demand

E. Need For Remote Monitoring

Modern treatment regimens entail monitoring patients continuously. For example, patients with heart conditions may need continuous blood pressure and heart rate monitoring. Diabetes patients may need regular monitoring of blood sugar and temperature. Continuous monitoring of outpatients is not possible with in-person care.

These are just a few of the many developments in the healthcare industry that have rendered in-person care unreliable. These developments necessitate digitization of care delivery in the sector. Digitization of care delivery is only realizable through the use of a Human-Machine Interfaces (HMIs).

III. HUMAN-MACHINE INTERFACE (HMI)

HMI is a user interface that allows humans to operate controllers for machines, systems, or instruments. Although HMIs are commonly used as input controls, they also serve as output controls, providing user feedback [2]. Some of the common types of HMIs in healthcare settings and their applications include:

- Touchscreen interfaces: Allow healthcare professionals to interact with medical devices through simple touch commands. They are common in bedside monitors, ventilators, and infusion pumps.
- Graphical user interfaces (GUI): They display complex data visually, such as imaging results or patient health trends. They are common in diagnostic imaging systems (e.g., MRI, CT scans) and electronic medical record (EMR) systems.
- Voice-controlled interfaces: Enable hands-free operation. Usually integrated with EMR systems and operating rooms.
- Gesture-based interfaces: Allow surgeons to control robotic arms using gestures.
- Wearable device interfaces: Provide real-time monitoring of vital signs. They include smartwatches, fitness trackers, and medical-grade wearables.
- Mobile applications: Enable remote patient monitoring and consultation. Commonly used in telemedicine.
- Brain-Computer Interfaces (BCIs): Help patients with severe disabilities to interact with technology using neural signals. Usually used in prosthetic control systems and communication aids for paralyzed patients.
- Augmented Reality (AR) and Virtual Reality (VR) Interfaces: Enhance patient mental health or physical rehabilitation therapy.

IV. IMPLICATIONS OF HMI TECHNOLOGY IN HEALTHCARE

Integration of HMIs in the healthcare sector has various benefits to providers and patients. Some of the core benefits of implementing HMIs include:

a) Automation and semi-automation of care delivery processes

HMIs are integrated with technologies such as AI that allow automation of data collection, data entry, and report generation processes. This allows staff to concentrate on other high-value roles that demand the attention of human experts.

These technologies also support multitasking, enhancing the productivity of the staff. For example, clinicians may use voice-controlled HMIs to serve patients in sterile environments while engaging with another patient in a consultation room.

b) Sharing of experts

HMIs, such as gesture-based interfaces, can be used by surgeons to control robotic arms in distant facilities. The technology can allow operators in Australia to perform surgeries in China without traveling. Telemedicine applications can also be used to hold distant specialist consultations. In this way, HMIs help address the challenge of limited specialists by allowing providers to share talents.

c) Remote care delivery

Remote care delivery is only viable via HMIs. Touchscreen interfaces and wearable device interfaces allow healthcare providers to remotely monitor patients and hold consultations. These technologies also enable providers to remit information to patients remotely.

d) Improved Patient Outcomes

The overall impact of HMIs is improved patient outcomes. The technologies allow patients to access high-quality care conveniently. Advanced interfaces, such as in robotic surgery or diagnostic imaging, enhance accuracy and reduce human error, ensuring high-quality care. Wearable devices and bedside monitors with intuitive HMIs provide continuous patient monitoring, alerting clinicians to critical changes. Lastly, HMIs enable real-time access to patient data, allowing healthcare providers to make quick and informed decisions [3].

e) Greater Patient Engagement

HMIs in wearable devices and mobile apps provide patients real-time insights into their health, promoting proactive self-care. Interactive patient portals and telemedicine platforms improve communication between patients and providers, ensuring better understanding and adherence to care plans.

f) Cost Savings

By automating routine tasks and streamlining workflows, HMIs reduce the time and resources required for patient care. These technologies facilitate preventive care. HMIs in remote monitoring devices help detect health issues early, preventing costly hospitalizations. Also, a lower incidence of medical errors translates to fewer malpractice claims and associated costs.

V. CONCLUSION

Although healthcare services are primarily delivered in person, recent developments in the sector have impelled providers to explore ways of providing care services virtually. HMI technologies are at the center of delivering these virtual services. Providers can remotely offer care services to patients in their homes or distant facilities using technologies such as wearable device interfaces, touchscreen interfaces, mobile applications, and gesture-based interfaces. These technologies are also integral in leveraging big data in care delivery. Because of the central role of HMIs in automating care delivery and providing remote care services, healthcare facilities that truly want to fully digitize their services must invest in deploying human-machine interfaces.

VI. SOURCES

[1] United Nations (2024), Population. Retrieved From: https://www.un.org/en/global-issues/population

[2] Malviya, R., Sundram, S., Prajapati, B., & Singh, S. K. (Eds.). (2023). *Human-Machine Interface: Making Healthcare Digital*. John Wiley & Sons.

[3] Gokul Ramadoss, "Revamping State Mandated Healthcare Reporting in the US", International Journal of Science and Research (IJSR), Volume 10 Issue 5, May 2021, pp. 1357-1360, https://www.ijsr.net/getabstract.php?paperid=SR24820000350, DOI: https://www.doi.org/10.21275/SR24820000350

[4] Butler Technologies (2021), How Does Human Machine Interfaces (HMI) Technology Benefit the Medical Industry? Retrieved From: https://butlertechnologies.com/blog/hmi-medical-industry

[5] Gokul Ramadoss 2021. “Leveraging Affordable Care Act to Improve Global Healthcare”, European Journal of Advances in Engineering and Technology, Volume 8, Issue 5, pp. 41-44. [Link]

[6] The Next Frontier in Healthcare Security: Leveraging AI for Enhanced Data Protection doi.org/10.47363/PMS/2024(8)E119

[7] Gokul Ramadoss 2021. “Imbibing Hedis (Health Care Effectiveness Data And Information Set) Measures For Improving Quality of Care”, International Journal of Core Engineering & Management, Volume 7, Issue 2, pp. 53-60. [Link]