

Healthcare 4.0: Importance and its benefits for workers' health and safety

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ABSTRACT

Also known as the 4th industrial revolution, this new era is characterized by the integration of advanced technologies, bringing significant innovations in several areas. Among these areas, we can list worker health and safety, enabling safer work environments and ensuring the well-being of employees. Therefore, this study aims to describe in a narrative way the benefits to worker health and safety, as well as the challenges with implementing healthcare 4.0 concepts. A bibliographic review was adopted as a methodology using the Virtual Health Library (VHL) and CAPES Periodicals Portal databases. In this context, it can be seen that in the same way that Industry 4.0 transformed manufacturing and other sectors, Healthcare 4.0 is revolutionizing healthcare by integrating advanced digital technologies to improve the prevention, protection and promotion of workers' health efficiently, personalization and quality of health services. Despite the positive aspects, the need to overcome ethical and privacy challenges related to the use of these technologies was identified, in order to ensure that workers' data is protected as well as transparency in the use of the information collected. However, the long-term benefits justify investments in technology and changing paradigms in occupational health management.

Keywords: Healthcare 4.0, Occupational health, Health, Security.

INTRODUCTION

In an increasingly digital era, the concept of Industry 4.0 emerges, also known as the 4th industrial revolution. This term was used for the first time at Hannover Messe, in 2011, by the German government, which aimed to promote significant changes in the operation of factories (MAVASI; SCHENETTI, 2017). This new era is characterized by the integration of advanced technologies, such as the Internet of Things (IoT), Artificial Intelligence (AI), Big Data, robotics, Cloud Computing, Virtual Reality (VR) and Augmented Reality (AR). Industry 4.0's main objective is to create smart factories, where machines, systems and products are interconnected, enabling more flexible, efficient and personalized production.

The introduction to the Industry 4.0 era has brought significant advances in several areas, including worker health and safety. With the application of Healthcare 4.0 concepts, new technologies and approaches are revolutionizing the way occupational health is managed, providing safer work environments and promoting employee well-being. The connection between technological deficiencies in the area of healthcare and the concept of Industry 4.0 followed another concept called Healthcare 4.0, which uses Industry 4.0 technologies for the benefit of health (ACETO; PERSICO; PESCAPÉ, 2019).

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In the context of safety and sustainability, the integration of safety systems and the efficient use of resources promote a safer and more sustainable work environment. IoT sensors and AI algorithms are used to continuously monitor working conditions, identify potential risks and implement preventative measures before accidents occur. This not only improves worker safety, but also increases the operational efficiency of factories (ISLAM et al., 2015).

Furthermore, Industry 4.0 is promoting mass customization and product customization at an unprecedented level. Thanks to Big Data analytics capabilities and the use of cyber-physical systems, factories can quickly adjust production to meet specific customer demands, reducing waste and increasing customer satisfaction (RÜßMANN et al., 2015).

The Industry 4.0 era is also bringing significant changes to the supply chain. With the use of technologies such as blockchain and advanced tracking systems, it is possible to guarantee the transparency and integrity of logistical processes, from the acquisition of raw materials to the delivery of the final product to the consumer. This results in more resilient and efficient supply chains (TREIBLMAIER, 2018).

In the healthcare sector, the application of Healthcare 4.0 technologies is transforming medical care. IoT -connected medical devices such as wearable health monitors and remote sensors enable continuous monitoring of patients, providing real-time data to healthcare professionals. This improves the responsiveness and precision of treatments, leading to better results for patients (DIMITROV, 2016).

Additionally, augmented and virtual reality is being used to train healthcare professionals, allowing them to practice complex procedures in a simulated environment before applying them in real situations. This not only improves the competence of professionals, but also increases patient safety (BARSOM et al., 2016).

Information integration and sharing through cloud computing is also crucial for the Industry 4.0 era. The ability to store and access data from anywhere facilitates collaboration between different sectors and regions, promoting innovation and the implementation of best practices more quickly and efficiently (MIRAZ et al., 2018).

Given this context, the Industry 4.0 era's main objective is to create smart factories, where machines, systems and products are interconnected, enabling more flexible, efficient and personalized production. This technological revolution extends to diverse sectors, including healthcare, transport, energy and services, promoting a digital transformation that is redefining the global economy. The integration of Healthcare 4.0 concepts is creating a safer, more efficient and healthier future for everyone involved, highlighting the importance of technology in the continuous evolution of society.



GOAL

The present study aims to describe in a narrative way the benefits to worker health and safety, as well as the challenges with implementing healthcare 4.0 concepts.

METHODOLOGY

The bibliographic review carried out using the Virtual Health Library (VHL) and CAPES Periodicals Portal databases was adopted as the methodology for formulating this study.

Data collection took place in April 2024 without restrictions regarding publication dates in order not to reduce the results. The findings were described during this research, highlighting the relevant aspects in relation to the importance and benefits of healthcare 4.0 in terms of worker health and safety.

DEVELOPMENT

Healthcare 4.0 is a concept that is based on the application of Industry 4.0 technologies in the healthcare sector. Just as Industry 4.0 transformed manufacturing and other sectors, Healthcare 4.0 is revolutionizing healthcare by integrating advanced digital technologies to improve the efficiency, personalization and quality of healthcare services. Healthcare 4.0 is, therefore, transforming the way healthcare is delivered, promoting a more integrated, efficient and patient-centered healthcare system (ECKERT et al., 2019).

The adoption of Healthcare 4.0 technologies has had positive impacts on the health and safety of workers, in addition to providing a good return for companies. The technologies involved contribute to the optimization and better performance of healthcare systems.

Continuous monitoring of workers' health is one of the advances provided by IoT. Devices such as smartwatches, activity bracelets, and wearable sensors enable real-time monitoring of workers' vital signs, such as heart rate, blood oxygen level, and body temperature (Dimitrov , 2016). By early identifying signs of fatigue, stress or other health problems, rapid interventions become possible, preventing occupational illnesses and improving the general well-being of workers. This monitoring can also be integrated into occupational health management systems, making it easier to monitor chronic conditions and adjust workloads as needed.

Safer working environments are guaranteed by IoT sensors and Big Data. Sensors installed on equipment and in the work, environment monitor factors such as temperature, humidity, air quality and exposure to dangerous substances (ISLAM et al., 2015). This technology allows collected data to be analyzed in real time to identify and mitigate risks, such as unhealthy environmental conditions or equipment failures, before they cause harm to workers. Furthermore, the use of predictive analysis can anticipate failures and dangerous conditions, enabling more efficient preventive and corrective actions.



Training and capacity building with R A and VR is also an important innovation. Tools like these are used to create realistic simulations of work scenarios, allowing workers to practice and train in a safe environment (BARSOM et al., 2016). In this way, we can contribute to improving workers' training, reducing the likelihood of workplace accidents and increasing efficiency in carrying out complex tasks. Additionally, these technologies can be used for training in emergency procedures, ensuring that workers are well prepared to respond to critical situations.

Predictive analysis and preventative maintenance are possible thanks to AI and Big Data. AI algorithms analyze historical and real-time data to predict equipment failures and risk conditions (TOPOL, 2019). Data-driven preventive maintenance reduces machine downtime, prevents accidents caused by equipment failures, and increases overall safety in the workplace. This approach can also be applied to occupational health management, anticipating health problems and proposing personalized interventions.

Personalized occupational health management is facilitated by Big Data and data analytics. The analysis of large volumes of workers' health data allows the personalization of occupational health programs, adapted to the specific needs of each individual (RAGHUPATHI; RAGHUPATHI, 2014). This allows the creation of personalized health and well-being programs that increase worker satisfaction and productivity, in addition to reducing absenteeism and turnover rates. Wellbeing programs can range from supervised physical activities to offering psychological support, all based on accurate data about workers' health.

The best emergency response is provided by IoT and alert systems. Connected IoT systems can send real-time alerts to emergency teams and security managers in the event of incidents (ISLAM et al., 2015). Rapid response to emergencies reduces harm and injury to workers and improves evacuation and rescue procedures. These systems can also be integrated with other technologies, such as drones for rapid assessment of risk areas and efficient communication with response teams.

Information integration and sharing are facilitated by cloud computing. Cloud computing allows for the secure storage and sharing of worker health and safety data between different departments and locations (MIRAZ et al., 2018). The systematization and integration of information facilitates the centralized management of occupational health and the implementation of safety policies consistently across the organization. This also improves transparency and communication between different sectors, promoting a more robust and efficient security culture.

Given this scenario, the integration of Healthcare 4.0 concepts is transforming the management of health and safety at work, creating a safer and healthier future for everyone involved. Emerging technologies not only improve the efficiency and personalization of healthcare, but also promote a safer working environment adapted to the needs of workers.



FINAL CONSIDERATIONS

It was evident that such technologies are being adapted to improve worker health and safety, bringing positive returns due to the easy and quick traceability of unsafe conditions and health problems. This allows us to work with the prevention and protection of workers' health.

These advances not only promote the well-being of workers, but also increase the efficiency and productivity of organizations, resulting in lower operating costs and a more satisfied and motivated workforce.

However, it is essential to consider the ethical and privacy challenges related to the use of these technologies, ensuring that workers' data is protected and that there is transparency in the use of the information collected.

The implementation of Healthcare 4.0 concepts has the potential to significantly transform worker health and safety, providing safer work environments and promoting the ongoing well-being of employees. Despite the challenges, the long-term benefits justify investments in technology and changing paradigms in occupational health management.



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