



## INTELLIGENT COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM FOR MEDICAL DEVICE MANAGEMENT

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### Abstract:

Healthcare represents the pillar of the population's wellbeing. All of the diagnostic processes have to be performed with significant diligence and caution. Even though artificial intelligence (AI) has become integrated into most human activities, its integration into healthcare is still in the beginnings mainly because of the ethical concerns. The most pronounced AI application in healthcare is in disease prediction, diagnosis and treatment where significant efforts are being made to automate these processes and expedite the process towards getting the diagnosis and proper treatment. However, this paper explores how the healthcare sector could benefit from integration of AI for the medical device management.

**Key words:** medical device, management, artificial intelligence;

### 1. Introduction

One of the sustainable development goals (SDG) of the United Nations Development Programme (UNDP) is good health and wellbeing for all [1]. This goal can only be achieved by making healthcare available and affordable to everyone. Availability and affordability i.e stability of healthcare depends on a variety of factors. The COVID-19 pandemic has taught the world about the importance of a stable healthcare system and while healthcare systems were collapsing in some countries as a result of a tremendous increase in the number of patients requiring immediate care, in other countries, stable healthcare systems have managed to regulate the influx of patients [2]. The success of these healthcare systems largely depended on adequate management, staffing and medical devices available.

EU4Health [3] is the European Union's (EU) ambitious response to COVID-19 with specific aim to strengthen health systems, their resilience and resource efficiency by strengthening health data,

digital tools and services, digital transformation of healthcare, developing and implementing EU health legislation and evidence-based decision-making integrated work among national health systems. Therefore, this program emphasizes the introduction of digital systems to all healthcare sectors, which was proven during the recent COVID-19 pandemics. Digitalization of healthcare systems is crucial to improve their performance and efficiency, but it is a step-by-step process. This paper explores the possibility of using artificial intelligence to improve medical device management systems in the context of digital systems.

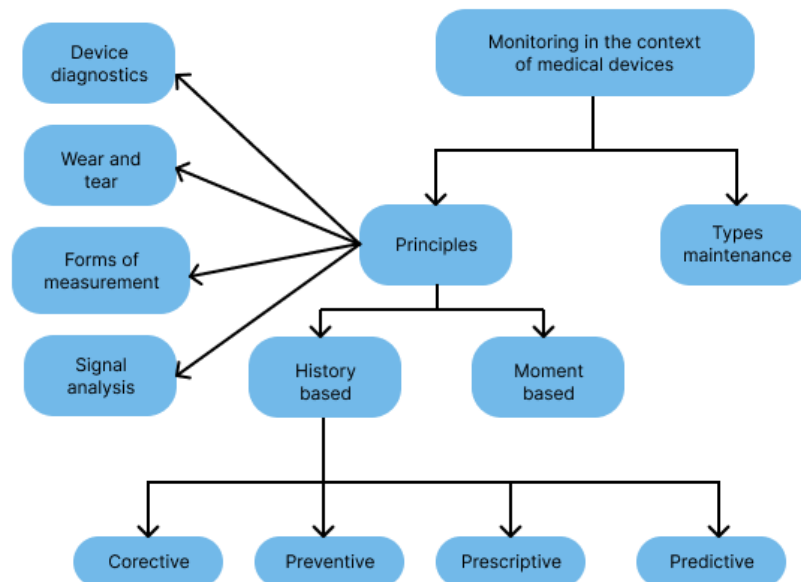
Medical devices are essential for a functioning health system, particularly important in the prevention, diagnosis, and treatment. According to the World Health Organization (WHO), there are around 2 million different types of medical devices on the market and over 7000 groups of medical devices [4]. Understanding that there are serious issues arising from the inappropriate deployment and use of medical devices, management of medical devices becomes a very important question in the healthcare system. Healthcare institutions should have defined policies for medical device management that are aligned with international standards, national regulation and manufacturers recommendations. However, this is not the practice in a large number of cases. For instance, a twostep study conducted by the WHO in 2010 and 2013 showed that most of the countries in the world do not have national standards or recommendations for medical devices [4]. This suggests that in those cases post-market surveillance of medical devices is uncertain and that management policies on healthcare institution level are not adequate as well. Additionally, budget constraints limit healthcare institutions' ability to perform regular preventive maintenance creating chaos in medical device management at institutional level. This in turn leads to increased incidence of patient injuries and death as a result of medical device malfunction [5]. This is the ecosystem which can largely benefit from rising digitalization efforts.

The idea of a computerized maintenance management system (CMMS) [6] for management of medical devices is not new. CMMS is a tool that can improve overall medical device management at the facility level [6]. The World Health Organization suggests that the information included in a CMMS varies depending on the individual situation, but always should include the medical device inventory and typically information such as service history, preventive maintenance procedures, performance indicators, and costing information. All of this represents valuable digital data which can be efficiently used to improve the outcomes of medical device management. Artificial Intelligence (AI) is a technology that can coordinate data delivery, analyze trends, develop data consistency, provide forecasts, and quantify uncertainties to make the best decisions. Therefore, this paper presents the concept of incorporating AI with CMMS for medical device management in order to create a predictive digital system that improves healthcare efficiency. Such an approach changes the current preventive maintenance paradigm into a predictive maintenance paradigm [7].

## 2. Artificial Intelligence for Medical Device Management

Digitalization makes a significant number of burdensome processes less time intensive and optimized to fit the digital era [8]. Artificial intelligence has already made its entrance into the field of medicine [9]. This work is mostly focused on disease prediction, classification, diagnosis and management [10-17]. The initial application of AI in healthcare was in image analysis systems that act as a support to clinical decision making. None of these systems work independently, and they serve as a reference point for clinicians to facilitate the final diagnosis. In a broader sense, classes of AI in healthcare include: vision and pattern detection, speech and natural language processing, expert clinician advice for assistance to caregivers or patients, autonomous surgical instruments or enhancements and closed-loop medical devices. Additionally, in developed systems, AI is incorporated into most electronic medical record systems with a variety of tasks such as reduction and potential elimination of errors, acceleration of medical decisions, improvement of healthcare quality, standard compliance, cost-effectiveness or satisfaction. Clinical decision support systems (CDDS) represent software-based AI tools that aid patients, nurses and clinicians in better decision making [18].

Similar to CDDS, CMMS can benefit from integration with AI. Current monitoring in the context of medical devices relies on four basic principles, and those are device diagnostics, wear and tear, forms of measurement, and signal analysis [26]. As it can be seen from Figure 1. integration with AI enables predictive management of a single medical device based on device previous performance and other relevant information. The strength of this predictive management can be improved by using device performance data periodically collected based on standardized procedure [20-25].



**Fig. 1.** Monitoring in the context of medical devices

In the context of healthcare, digitalization in healthcare institutions is currently in the scope of patient flow, staffing, scheduling and supply chain management. All of the previously mentioned are crucial for proper functioning of a healthcare institution and digitalization was necessary in order to follow up with the rising needs of healthcare. In the context of staffing, machine learning algorithms are effectively used to predict nurse absence but they can also be used for analysis of interconnectedness between the staff members with an aim of constructing the most productive teams. In the context of patient flow, machine learning was effectively used to predict the time a patient will need to spend in an intensive care unit and also to predict the expected numbers of patients admitted, discharged or transferred between hospital wards. This leads to a better turnover process that reduces the length of stay and optimizes the usage of healthcare facilities. Digitalization and AI based scheduling of procedures leads to better resource management and the ability to optimize the workflows to facilitate maximum number of procedures conducted in a day. In this context, different sectors within healthcare facilities can benefit from such intelligent CMMS. First, clinical engineering departments would benefit from predictive management of medical devices. They would have enough data to monitor device performance and predict possible failure, thus decreasing the risk of injury caused by medical device occurring to the patients. The aspect of preventive maintenance automates the work orders for equipment maintenance based on time, use or triggered events to sequence and schedule preventive work orders while decreasing the downtime of the equipment. Second, management of healthcare facilities would have an evidence-based approach when planning preventive maintenance and device procurement.

### **3. Conclusion**

Digitization of processes has significantly benefited all businesses and increased productivity of all sectors. Artificial intelligence, as one of the drivers of digitalization has advanced planning, scheduling and automated a significant number of processes.

The healthcare sector, due to its tangibility and importance of attention to slightest of details is still not automated to a significant extent, however steps are taken to ensure that.

Application of AI for disease prediction, diagnosis and management is one of the main drivers of AI in medicine.

Using AI for medical device management is still not applied, but research supporting application of AI in medical device management is under way.

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