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Chapter 6: AI-Driven Robotics and Automation in Modern Healthcare: Revolutionizing Precision, Efficiency, and Care

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Abstract: Artificial Intelligence (AI), robotics and automation are merging into an integrated platform to transform how healthcare delivers quality, efficiency, and patient centric care. From simple mechanical aids to sophisticated AI assisted surgery platforms, robotics have transformed in healthcare and from basic data entry, automation has also transformed from simple to complex intelligent process management. The core technologies that drive these transformations include, Computer Vision, Natural Language Processing, Reinforcement Learning, and Cloud Robotics via Internet of Things (IoT) driven robotics. Robots are now being used in a wide variety of applications in the healthcare industry, which include robotic-assisted surgery, hospital service robots, rehabilitation and assistive devices, and laboratory diagnostics and automation. As robotics continues to evolve, new emerging trends, which include Collaborative Robots (Cobots), Humanoid Assistants, Swarm Robotics, Generative AI, Digital Twin Technology will continue to redefine patient care, medical research and healthcare delivery. While there are many positive implications of utilizing AI and robotics in the healthcare industry, there are still several barriers or challenges to overcome prior to its full implementation in the healthcare delivery system, which include Cost, Accessibility, Data Security, Ethics and Workforce Displacement. In the future, AI driven robotics may play an important role in the advancement of personalized medicine, Smart Hospitals, and Home-Based Healthcare, creating a collaborative ecosystem between the human expertise and intelligent machines for safe and sustainable healthcare systems.

Keywords: *Data-driven R&D, Drug and Vaccine Development, Predictive Modelling and Virtual Screening, Microbial Genomics and Metagenomics, Epitope Prediction.*

1. Introduction