

Chapter 10


Machine Unlearning Models for Medical Care and Health Data Privacy in Healthcare 6.0

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ABSTRACT

The integration of advanced technologies in healthcare has undergone significant transformations throughout the 20th and 21st centuries, culminating in the era of Healthcare 6.0. This evolution in healthcare, particularly the integration of artificial intelligence, has necessitated the implementation of concepts like “Machine Unlearning”. This is crucial for addressing critical issues like data privacy compliance, bias mitigation, and data security. By enabling the removal of specific data points from ML models, Machine Unlearning aligns with international data protection laws (HIPAA, GDPR, and DPDPA). Its application emphasizes regulations concerning the right to be forgotten, data minimization, and patient consent, which are essential for legal compliance and maintaining patient trust in healthcare. This chapter discusses Machine Unlearning approaches like Exact Unlearning and Approximate Unlearning, along with other advanced methods. Lastly, it discusses real-world case studies, and identifies the way forward for future development & research on 'Machine Unlearning in Healthcare'.

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INTRODUCTION

Evolution and Overview of Healthcare 6.0

Combining management and healthcare delivery is seen as a critical strategy for improving service outcomes and the performance of health systems worldwide. Over the years, in accordance with the industrial progression, evolution of management sciences, and the adoption of technology across sectors, healthcare as a discipline has also seen tremendous development.

The transformation of healthcare management saw its first revolution in the mid-20th century, with Healthcare 1.0 (Chanchaichujit et al., 2019), which brought to light the emphasis on service efficiency and minimizing bureaucracy in healthcare. Advanced data-centric systems and concepts like telehealth were first discussed as measures to manage medications and treatment by clinicians, and automation was introduced in the form of administrative systems. However, the data remained siloed with individual health providers.

In the late 20th century, internet and technology became more accessible, and the users transformed from being customers of web resources to producers of information and content. This led to the production of more scientific research and evidence-based medicine. In this era of Healthcare 2.0 (Randeree, 2009), the delivery of services by healthcare institutions became more structured, and personal health records emerged as a tool to provide control and access to patients' data. The focus shifted to technological enablement for active engagement of patients in their treatment and better patient-provider relationships.

The next phase of development in the early 21st century focused on the concept of managed care and provisioning preventive care before the actual disease onset. In Healthcare 3.0 (Pillay, 2018, & Ristevski et al., 2018), technologies like big data analytics and wearables for early screening entered healthcare and brought preventive care in focus. Electronic Medical Records (EMR) became the means of making health services more individualistic and proactive.

In the first decade of the 21st century, healthcare started fully embracing digital technologies like telemedicine, mobile health apps, and remote sensing for treatment delivery beyond the premises of a health center. In Healthcare 4.0 (Gupta & Singh, 2023), the emphasis came on enhanced data collection and sharing capabilities, leading to interoperability and connected healthcare systems. By empowering patients with IoT (Internet of Things), Big Data analytics, and virtual care, this development made health systems more patient-centric, thus moving away from their traditional hospital-centric approach.

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