Chapter 10
Personalizing Medicine for Fake Drug Prevention With AI–Driven Digital Twins

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ABSTRACT

As the day unfolds, we can no longer overemphasize on the negative impact of fake drugs in under-developed countries and in the whole world at large. The healthcare system has greatly been negatively affected by the illegal production of counterfeit

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drugs which results compromised patient safety, waste of money for healthcare, and causing lack of trust on the healthcare system in place. In this chapter on personalising medicine for fake drug prevention with AI-driven Digital Twin, digital twins are emerging as powerful tools. The virtual patient models combine multimodal data, such as clinical, genomic, and imaging information, in order to simulate an individual's health trajectory and response to treatment.

1. INTRODUCTION

Globally, counterfeit drugs represent a growing threat to public health, eroding trust in medical systems, and endangering pharmaceutical integrity. As a result of fraudulently mislabeling pharmaceutical products with regard to their identity or source, counterfeit drugs often contain incorrect dosages, harmful substances, or no active ingredients at all (Newton et al., 2011). According to the World Health Organization (WHO), approximately 1 in 10 medical products in low- and middle-income countries is substandard or falsified, resulting in preventable deaths, financial losses, and adverse health outcomes (WHO, 2020). The rise of counterfeit drugs poses a significant global threat, affecting public health, trust in healthcare systems, and the pharmaceutical industry's integrity. The World Health Organization (WHO) estimates that one in ten medical products in low- and middle-income countries is substandard or falsified, leading to adverse health outcomes, financial losses, and preventable deaths. Digital twin technology combined with artificial intelligence offers a transformative solution to the counterfeit drug crisis, addressing the limitations of traditional methods and enabling a scalable, adaptive framework for public health protection. An AI-driven digital twin system for pharmaceutical supply chains and healthcare system in general is presented here, along with challenges and potential benefits for ensuring the integrity of medical products and protecting consumers globally. Combating this challenge demands innovative solutions that leverage advanced technology to ensure the authenticity, safety, and efficacy of medications. This chapter explores the critical scope of this issue and underscores the need for innovative, AI-driven Digital Twins solutions to combat counterfeit drugs.

The impact of counterfeit drugs extends across multiple dimensions, including public health, healthcare systems, and economic stability. Public health bears the brunt of this crisis, as counterfeit drugs contribute to therapeutic failures, drug resistance, and mortality. For instance, falsified antimalarial drugs are estimated to cause over 116,000 deaths annually in sub-Saharan Africa (Krähenbühl et al., 2018). Counterfeit antibiotics and vaccines further exacerbate global health challenges, particularly in regions with fragile healthcare infrastructures.