


Chapter 10

Introduction to Machine Learning in Cancer Care

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ABSTRACT

Machine learning (ML) is revolutionizing oncology by enhancing diagnostic accuracy, prognostic predictions, and personalized treatment strategies. This chapter explores the integration of ML into cancer care, focusing on its applications in medical imaging, molecular profiling, and treatment optimization. Advanced algorithms, such as convolutional neural networks (CNNs), have demonstrated diagnostic accuracy comparable to or surpassing human experts, while techniques like radiogenomics bridge imaging and genomic data for non-invasive diagnostics. Despite these advancements, challenges such as data heterogeneity, model interpretability, and ethical concerns—including patient privacy and algorithmic bias—remain significant barriers to clinical implementation.

1. INTRODUCTION

The study of oncology is a fast-growing discipline, with the growing use of machine learning (ML) algorithms in the clinical process. Machine learning (ML)

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in clinical oncology has diverse clinical implications in terms of enhancing diagnostic and prognostic accuracy and the personalisation of therapeutic decisions. This part is dedicated to the implementation of modern technologies in the clinical field logistics. The question of its primary research is the following: How can ML be applied successfully in the clinical workflow of oncology to enhance clinical outcomes, considering the diversity of data sources, interpretability, and ethics? This question is the stimulus of the current work.

Machine learning is a field of AI and has become a household in most industries. This might be particularly applicable to the healthcare sector, as cancer is a complicated, dynamic condition on the molecular, genetic, and phenotypic levels. Therefore, machine learning has increasingly been applied in oncology because the ability to extract patterns in vast amounts of medical imaging, genomic, and EHR data has established an ability to individualise cancer care to a degree that is more accurate. The section will address the background and early understanding of ML that would be instrumental in explaining its use in healthcare, including a brief history of the history of AI in oncology and some of the applications of machine learning to further cause precision oncology.

2. MACHINE LEARNING FUNDAMENTALS IN HEALTHCARE

It is necessary to learn the fundamental concepts and processes of machine learning to use its revolutionary potential in healthcare, especially in oncology. In this section, I am going to discuss the core algorithms and data processing methods and measures which are the basis of practical AI applications. Creating these basics, the work preconditions the understanding of the sophisticated improvements of machine learning to diagnostics, prognosis, and personalised treatment in cancer care.

2.1 Core Algorithms and Architectures

Machine learning in oncology aims to support diagnostic and prognostic applications, as well as treatment planning and decision-making. Supervised learning uses labelled data, such as histopathological images, to classify input data, malignant or benign tumours. This is used in reproducible oncological diagnoses with measurable performance characteristics (Introduction to Machine Learning in Cancer. The cost, time, and resource requirements to collect labelled data can lead to a need to reduce the required amount through semi-supervised and active learning techniques.

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