Crimson Publishers
Wings to the Research

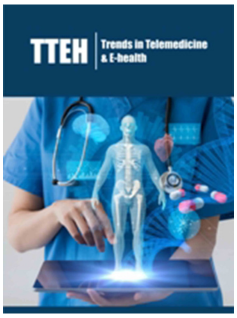
Opinion

The Benefits of KIML in Cancer Treatment

Gong Chen, Yongheng Liao, Luxi Dong, Xiaolan Xie and Shuiwang Li*

College of Computer Science and Engineering, Guilin University of Technology, China

ISSN: 2689-2707



***Corresponding author:** Shuiwang Li, College of Computer Science and Engineering, Guilin University of Technology, Guilin, 541006, China
Email: lishuiwang0721@163.com

Submission: February 03, 2025
Published: February 06, 2025

Volume 5 - Issue 2

How to cite this article: Gong Chen, Yongheng Liao, Luxi Dong, Xiaolan Xie and Shuiwang Li*. The Benefits of KIML in Cancer Treatment. Trends Telemed E-Health. 5(2). TTEH. 000610. 2025.
DOI: 10.31031/TTEH.2025.05.000610

Opinion

The complexity and heterogeneity of cancer pose significant challenges to traditional treatment methods, driving the development of Knowledge-Informed Machine Learning (KIML) [1]. KIML integrates biomedical knowledge to address issues such as limited sample sizes, high data dimensionality, significant tumor heterogeneity, and lack of model interpretability in traditional machine learning models, providing more precise tools for cancer diagnosis and prognosis [2]. The core of KIML lies in learning from hybrid information sources, which include both data and prior knowledge. Prior knowledge originates from independent sources and is typically represented in a formalized manner, such as logical rules, knowledge graphs, or simulation results. This knowledge is explicitly integrated into the machine learning pipeline. The main distinction between KIML and traditional machine learning is that while traditional methods primarily rely on data-driven learning, KIML introduces external knowledge to provide additional guidance to the model.

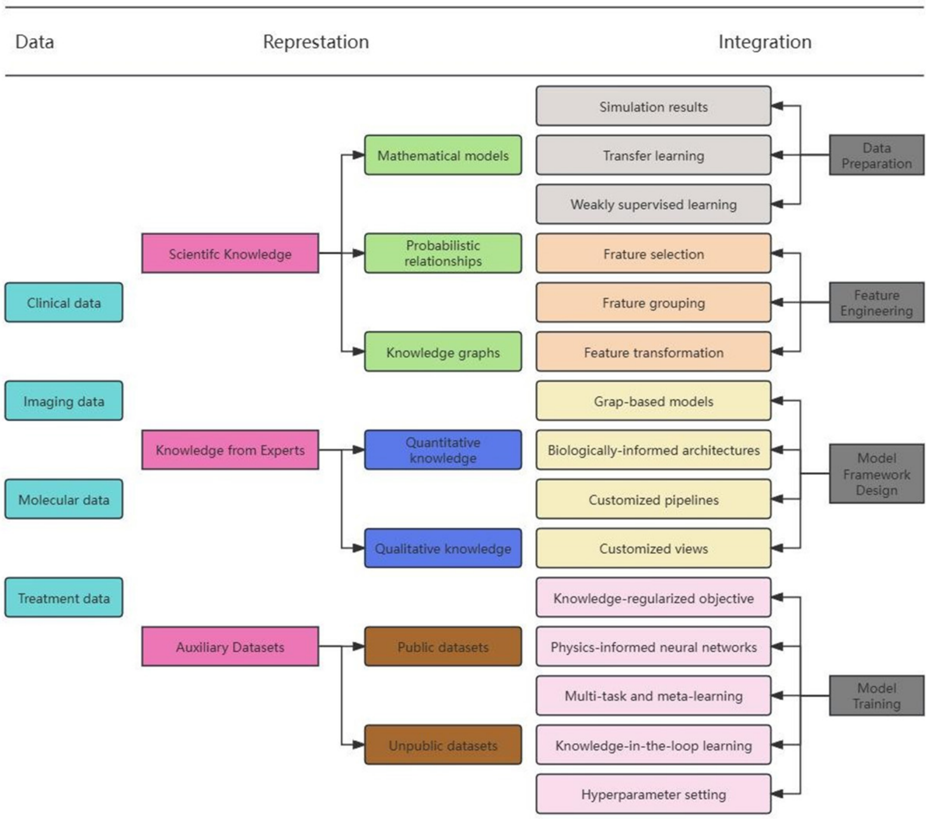


Figure 1: Classification of knowledge-informed machine learning in cancer diagnosis and prognosis. It is categorized from the existing three dimensions: Type of data, form of knowledge representation, and strategy for knowledge integration.

Figure 1 further elucidates the application framework of KIML, demonstrating how various types of data (such as clinical data, imaging data, molecular data, and treatment data) can be integrated with knowledge representations (including scientific knowledge, expert knowledge, and auxiliary datasets), and incorporated into the machine learning pipeline through diverse strategies (such as data preparation, feature engineering, model framework design, and model training). This framework not only underscores KIML's potential to enhance model performance but also highlights its role in facilitating knowledge sharing and supporting medical decision-making (Figure 1).

When handling complex cancer-related data, traditional machine learning models often face challenges due to limited data samples or high data dimensionality. In contrast, Knowledge-Informed Machine Learning (KIML) can effectively address these issues by incorporating prior knowledge. For example, KIML can use mathematical models and probabilistic relationships to better identify key features in the data, which enhances model accuracy [3]. This approach also helps reduce the risk of model overfitting, ensuring reliable predictions even with small sample sizes. Integrating expert knowledge and auxiliary datasets further prevents model performance degradation caused by insufficient data, making a significant contribution to cancer research and clinical applications [4]. The progress of KIML is closely linked to advancements in cancer research and clinical applications [5]. By integrating biomedical knowledge, KIML facilitates knowledge sharing, supporting more sustainable cancer research and clinical applications. It improves communication between doctors and patients, fosters greater interaction among medical colleagues, and gradually supports complex medical decision-making processes.

As technology continues to advance and the demand for precision in cancer treatment increases, KIML is poised to play a more significant role in the future. It will enhance the accuracy of cancer diagnosis and prognosis while driving the digital transformation of the healthcare industry [6]. The development of KIML will also promote the rational allocation of medical resources, enabling more people to access high-quality medical care regardless of their location. KIML is not just a temporary solution to the complexity of cancer but an important direction for future healthcare development. It plays a key role in improving global health standards and advancing medical technology.

References

1. Travers C, Daniel SH, Brett KBJ, Alexandr AK, Brian TD, et al. (2018) Opportunities and obstacles for deep learning in biology and medicine. J R Soc Interface 15(141): 20170387.
2. Mariam JH, Sergio AQ, James L, Charles S (2015) Translational implications of tumor heterogeneity. Clin Cancer Res 21(6): 1258-1266.
3. Williams PD, Siân J, Xiaosong Z, Jimmy CHL, Rebecca JL, et al. (2008) An integrated genomic analysis of human glioblastoma multiforme. Science 321(5897): 1807-1812.
4. Janiszewska M (2020) The microcosmos of intratumor heterogeneity: The space-time of cancer evolution. Oncogene 39: 2031-2039.
5. Xuetao L, Jun H (2018) A richer understanding of intratumoral heterogeneity: Single-cell genomics put it within reach. J Thorac Dis 10(3):1178-1182.
6. Lin S, Haoyu R, Xi Y, Jian L, Ziwei C, et al. (2021) The era of radiogenomics in precision medicine: An emerging approach to support diagnosis, treatment decisions, and prognostication in oncology. Front Oncol 10: 570465.