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Editorial

The role of artificial intelligence in the epidemiological surveillance of infectious diseases

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Epidemiological surveillance, based on the collection, analysis, and management of data, is the traditional and key tool for identifying and describing infectious diseases involving emerging (new) or re-emerging agents (those with extremely low incidence rates). However, with the massive growth of epidemiological information, which now includes "Big Data" frequently containing irrelevant or "dirty" data, surveillance becomes complex and slow, hindering the provision of accurate information for public health decision-making in the prevention of epidemics and pandemics, or in the containment of pathogen transmission [1].

To prevent the epidemiological surveillance of infectious diseases from being overwhelmed as an early health alert mechanism. Artificial intelligence (AI) can be applied due

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to its ability to integrate data science and process automation with statistical, mathematical, and computational techniques, governed by efficient algorithms that enable effective data processing and the identification of early signals. This capability is particularly valuable for inferring the epidemiological behavior of pathogens, especially unpredictable infectious diseases caused by viruses, bacteria, fungi, and parasites [2].

AI utilizes machine learning, which allows the acquisition of knowledge based on experience, without new programming, to act in similar or different situations, with algorithms that use labeled data (supervised learning) or without them, but by grouping data with similarities (unsupervised learning), without distinguishing between training and test data. In supervised AI learning, regression models (linear, nonlinear, and neural networks that simulate how the brain processes information) are used to study the relationship between dependent and independent variables [2].

Also within the context of supervised learning, AI uses classification models (Bayesian classifier, decision trees, discriminant analysis, and the k-neighbors method) to predict possible outcomes. Unsupervised AI learning is used to handle large amounts of data, employing clustering models (which group objects according to their characteristics) and partitioning models (which require specifying the desired group size), focusing on association rules and dimensionality reduction [3].

Consequently, AI enables the modeling of the spread of infectious disease agents using machine learning and its subset, deep learning (artificial neural networks arranged in multiple layers). This is because it allows for the description of epidemiological trends in emerging pathogens (about which little or no information is available) or re-emerging pathogens (with a vast amount of data). This is especially useful for establishing diagnostic strategies, appropriate treatment, and particularly for controlling transmission, with a comprehensive approach to data use, free from group, arithmetic, or algorithmic biases [4].

Using representative and even heterogeneous databases, AI in epidemiology facilitates the study of health determinants and the prediction of risk of occurrence through fine-tuning approaches or transfer learning of pre-trained networks and self-supervised learning. It allows researchers to go beyond simply obtaining observational data typical of traditional surveillance (case-control studies, cohorts, or household surveys) and estimating epidemiological parameters (case fatality rate, transmissibility, serial and generational intervals, and heterogeneity of transmission) [5].

AI overcomes the imperfect observation of traditional surveillance in the context of the actual chain of transmission, the location where it occurs, the duration of the incubation period, and the intensity of transmission. Furthermore, AI eliminates censorship and unequal data reporting, aspects that are beneficial in the design of health plans and programs for the control of infectious diseases. In short, the role of AI in epidemiological surveillance is promising [2].

1. CONFLICT OF INTERESTS

The authors have no conflict of interest to declare. The authors declared that this study has received no financial support.

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