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ARTIFICIAL INTELLIGENCE IN PUBLIC HEALTH SURVEILLANCE: OPPORTUNITIES AND PRIVACY CONCERNS

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Abstract. This article analyzes the potential of artificial intelligence (AI) technologies in public health monitoring and the emerging privacy issues. AI is an effective tool for early detection of epidemics, tracking the spread of disease, and effectively managing health resources. At the same time, a number of problems related to personal privacy and data security arise during data collection and processing. The article highlights the importance of anonymization, consent, and cybersecurity measures to ensure privacy, and provides necessary recommendations for the safe and effective use of AI technologies in the health sector.

Keywords: Artificial intelligence, public health monitoring, privacy, data security, epidemic detection, anonymization, consent, cybersecurity, ethics, technological innovations.

In modern times, artificial intelligence (AI) technologies are widely used to improve the effectiveness of public health monitoring. With the help of SI, it is possible to quickly and accurately analyze large amounts of health data, predict the spread of diseases, and control epidemics. In particular, the COVID-19 pandemic has further increased the importance of SI technologies in public health. However, the collection and use of personal health data raises serious privacy concerns. This article examines the potential of SI technologies in public health monitoring, emerging privacy concerns, and measures to address them.

Traditional health monitoring systems are often highly dependent on the human factor, and the processes of data collection and analysis are mainly carried out manually by health professionals - doctors, epidemiologists, and other staff. In these processes, data is collected from hospitals, clinics, and other medical institutions, and then

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organized and analyzed to identify disease trends and epidemics. However, such traditional methods often suffer from slow data entry and reporting, especially in the early, critical stages of an outbreak. This information lag makes it difficult for health systems to respond in a timely and effective manner. As a result, measures needed to prevent the rapid spread of an epidemic or disease are delayed, posing a significant risk to public health.

In addition, traditional health surveillance systems are largely reactive, focusing only on identifying and investigating outbreaks that have already occurred. They lack or only have limited predictive capabilities. This prevents health leaders and professionals from being able to anticipate the spread of diseases and take timely preventive measures and allocate resources effectively. Especially in densely populated or economically disadvantaged areas, the lack of predictive analysis and forecasting is a major obstacle to effective control of infectious diseases.

The effectiveness of traditional surveillance systems can also be limited by poor data quality and incompleteness. In many cases, inaccurate reporting, incomplete or delayed reporting of disease information are observed. Such inaccuracies lead to errors in health policy and decision-making processes, make it difficult to understand the true state of the epidemic and lead to ineffective measures. In addition, gaps in the monitoring process arise due to the lack of integration between different health information systems. As a result, certain areas or specific population groups remain under-monitored, creating conditions for the hidden spread of diseases.

Therefore, today there is a growing need to further improve health monitoring systems. To increase their effectiveness, it is important to improve the accuracy of data, increase speed and expand predictive capabilities. For this, the introduction of digital data collection tools, geographic information systems (GIS), as well as artificial intelligence (AI) technologies is being considered. These innovations will expand the scope of health monitoring systems, quickly and accurately process data, and identify epidemics in advance. As a result, the global health system will be significantly strengthened in responding to epidemics quickly and effectively preventing their

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spread. Such developments will fundamentally improve international disease control and prevention strategies and improve the quality of health care worldwide. AI algorithms can automatically analyze large data sets and make predictions based on the results. AI is used in public health in the following key areas:

Early disease detection and prediction: AI analytical models are effective in predicting the spread of diseases in advance, including in predicting epidemics of infectious diseases.

Real-time monitoring: Real-time data collection and analysis enables health systems to respond quickly.

Health resource management: Helps identify and allocate necessary medical resources during epidemics where they are most needed.

Disease spread tracking: Geolocation data and social network analysis can be used to determine the geographical spread of diseases.

AI-based systems can provide faster and more accurate results than traditional methods for disease tracking.

Artificial intelligence (AI) can play a particularly important role in the field of behavioral epidemiology, which uses data from mobile applications and social networks to analyze people's health-related behaviors, such as diet, physical activity, and mobility. SI allows us to track changes in these behaviors and evaluate the effectiveness of various interventions aimed at improving health. SI also contributes to a holistic understanding of health problems by modeling the relationship between these behaviors and the spread of diseases. Machine learning algorithms have been effectively used to identify people's emotions and beliefs in social networks, and have led to many useful applications, especially in the field of mental health. For example, in the context of environmental health, SI-based tools use machine learning methods to continuously monitor air quality in cities, which can help prevent environmental health problems.

AI also plays a key role in more efficient allocation of health resources. During COVID-19 vaccination campaigns, AI models were used to analyze demographic,

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health records, and geographic data to identify the most suitable locations for vaccination sites. This allowed for optimal resource allocation according to population needs.

AI is also becoming increasingly important in health communication. AI tools can segment populations based on demographic and behavioral data, making health messages more culturally relevant and more likely to be accepted. For example, methods such as k-means clustering and lasso regression can improve message effectiveness. AI can also help create health messages in multiple languages, adapt to different levels of health literacy, and detect misinformation.

AI-based chatbots are also providing new opportunities for delivering health messages. During the COVID-19 pandemic, the World Health Organization (WHO) used AI-based chatbots on platforms such as WhatsApp to share real-time information about the virus, symptoms, preventive measures, and vaccination guidelines. Recent analyses show that chatbots are effective in dispelling misinformation, providing rapid responses, and directing the public to reliable sources.

AI systems used for public health monitoring often collect personal health data, which raises the following issues:

Disclosure of personal data: If data is not adequately protected, it can be leaked to third parties or used illegally.

Challenges in anonymizing data: In some cases, anonymization is not effective enough, leaving individuals identifiable.

Consent and ethical issues: Using data without the consent of the data subjects is ethically problematic.

Security in data storage and transmission: Cyberattacks can lead to data corruption or theft.

Inconsistency in legal and regulatory standards: In some countries, regulations for handling health data are not sufficiently developed.

The integration of artificial intelligence (AI) technologies into health systems is becoming increasingly important in improving global health. However, current AI

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models have limitations and cannot work effectively in complex and uncertain situations. These limitations slow down the development of new AI models and delay the equitable use of technology. It is especially important to understand social inequalities and the application of AI in health, especially in developing countries.

Fan and colleagues have proposed a new approach to address this problem: they have developed a methodological framework and three algorithms for integrating large amounts of geographic data into deep learning models. This approach differs from conventional models, which are very data-intensive and limited to a specific area. It uses representative data that is appropriate for the size of the decision-making process for each geographic context. This can significantly improve the effectiveness of AI models that can be widely used in different climatic, demographic and socio-political settings. For example, data from countries such as Brazil, Mexico and the Philippines reflect the complex and changing patterns of dengue fever emergence and disappearance. Each region has its own characteristics - for example, weather patterns vary differently in cities, provinces, districts or municipalities.

This approach is expected to bring significant benefits to developing and low-income countries, as it allows for greater cross-regional and global collaboration. However, socio-economic uncertainties and weak infrastructure can hinder the equitable and widespread use of health AI technologies in these countries. In particular, there are challenges in collecting sufficient data, establishing databases, and providing technical tools. In addition, the cost of access to scientific literature and prestigious journals, which is higher than the GDP of many countries, poses challenges for developers and researchers.

Thus, while AI offers great prospects for health, it is necessary to address not only technological but also social and economic challenges to bring them to developing countries in a fair and effective way. International cooperation in this regard and equitable distribution of resources can increase the real benefits of this technology for people.

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The following key measures are recommended to protect privacy while taking advantage of the benefits of AI technologies:

Data anonymization and de-identification: Making data non-personal, reducing the possibility of identifying individuals.

Obtaining user consent: Obtaining consent in a clear and understandable form before data is collected.

Strengthening cybersecurity measures: Implementing modern encryption methods and security protocols.

Developing ethical and legal norms: Strengthening international standards and national laws on privacy and data security.

Informing and educating users: Increasing trust by providing open information about how data is collected and used.

Furthermore, despite the rapid development of AI capabilities, its widespread use in health systems must be carefully managed. In the process of introducing technology, not only its benefits but also the negative consequences that can be misused or lead to discriminatory results should be carefully studied. Therefore, it is important to develop international rules, standards and ethical norms for the use of AI in global health monitoring systems. These standards will not only ensure the safe and effective operation of the technology, but also take into account human rights and ethical principles in its use.

Also, close cooperation between countries and organizations is necessary for the successful implementation of AI technologies.

In other words, while artificial intelligence offers great opportunities for revolutionary changes in health monitoring, its implementation must be carefully managed, based on the principles of fairness and cooperation. In this way, the technology can become an effective and sustainable tool for the well-being of humanity.

In addition, artificial intelligence is becoming an important tool for early detection of epidemics, prediction of the likelihood of the spread of infectious diseases, and

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identification of risk groups by analyzing general population health data. This creates the basis for increasing the level of preventive measures and preparedness of the health system, as well as for rapid response to emergencies.

At the same time, the introduction of AI technologies into the health system also raises some important issues. First of all, it is important to ensure the protection of patients' personal health data when working with these technologies. Strict policies and approaches are needed to ensure data security, protection from unauthorized access, transparency, and reliability when using artificial intelligence systems.

Another important issue is the algorithmic bias that may arise in AI systems. If these algorithms are developed on the basis of incorrect data or operate in a way that is contrary to the interests of certain groups, this can negatively affect the quality of clinical decisions and equity in health care. Therefore, measures should be taken to continuously identify and eliminate biases in algorithms when developing and using AI systems. It is also important to develop and implement fair and inclusive policies to achieve equal opportunities and equal health outcomes for all citizens, especially the socially vulnerable.

Artificial intelligence also offers great opportunities in health care. However, for its full and safe operation, along with technological development, it is necessary to carefully address ethical, legal and social issues.[1]

In conclusion, AI offers new opportunities for early detection of diseases, epidemic management, and efficient resource allocation in public health monitoring. At the same time, ensuring the privacy and security of personal data remains a pressing issue. The anonymization, consent, and cybersecurity measures outlined in the article provide a foundation for the safe and effective use of AI technologies. In the future, protecting privacy and ethical principles will be important for the development and rational use of AI technologies in public health.

[1] Price, W. N., & Cohen, I. G. (2019). Privacy in the age of medical big data. Nature Medicine, 25(1), 37-43. https://doi.org/10.1038/s41591-018-0272-7

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