Artificial intelligence in public health: promises, challenges, and an agenda for policy makers and public health institutions

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Artificial intelligence (AI) can rapidly analyse large and complex datasets, extract tailored recommendations, support decision making, and improve the efficiency of many tasks that involve the processing of data, text, or images. As such, AI has the potential to revolutionise public health practice and research, but accompanying challenges need to be addressed. AI can be used to support public health surveillance, epidemiological research, communication, the allocation of resources, and other forms of decision making. It can also improve productivity in daily public health work. Core challenges to its widespread adoption span equity, accountability, data privacy, the need for robust digital infrastructures, and workforce skills. Policy makers must acknowledge that robust regulatory frameworks covering the lifecycle of relevant technologies are needed, alongside sustained investment in infrastructure and workforce development. Public health institutions can play a key part in advancing the meaningful use of AI in public health by ensuring their staff are up to date regarding existing regulatory provisions and ethical principles for the development and use of AI technologies, thinking about how to prioritise equity in AI design and implementation, investing in systems that can securely process the large volumes of data needed for AI applications and in data governance and cybersecurity, promoting the ethical use of AI through clear guidelines that align with human rights and the public good, and considering AI's environmental impact.

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Introduction

There is no consensus on a definition of artificial intelligence (AI), but WHO has proposed "the performance by computer programs of tasks that are commonly associated with intelligent being".[1] AI is seen by many as having the ability to revolutionise health systems. It can rapidly analyse large and complex datasets, extract recommendations tailored to patients or settings, support decision making, and improve the efficiency of many tasks that involve processing data, text, or images. These capabilities have captured the attention of policy makers at national and international levels. However, many will know, especially those with experience in procuring technology, that the benefits of AI can be exaggerated and the risks downplayed. These risks include potential data privacy breaches, misinterpretation of results, perpetuation of biases, and the danger of professionals becoming over-reliant on technology, leading to the erosion of critical skills.

The literature on health-related AI is expanding rapidly, but the plethora of literature can be daunting for policy makers as much is written in highly technical language, and separating aspirations from reality can be difficult. Although much of this literature focuses on basic health sciences (such as genomics) or clinical applications (such as diagnostic aids), there are many potential AI applications in public health.[2–5] In this Viewpoint, we explore some of these opportunities and the challenges that accompany them, building on previous work carried out for the European Observatory on Health Systems and Policies[6] and WHO.

How could AI be used to deliver public health activities?

Traditionally, public health surveillance relies on manual data collection and analysis, which can be time consuming and prone to errors. AI can transform this process by automating data analysis, quickly identifying potential outbreaks, and issuing timely warnings. For example, the US Centers for Disease Control and Prevention used AI to track the spread of COVID-19 during the pandemic by combining data from multiple sources, such as electronic health records, social media, and news outlets.[7]

AI can also assist in monitoring trends in risk factors for non-communicable diseases by analysing demographic, behavioural, and environmental data and feeding these data into projections used in planning. AI's ability to process large volumes of data rapidly can speed up the flow of information. For instance, AI can extract and analyse free-text data from sources such as death certificates to identify drug-related deaths well before formal coding processes are completed.[3] This type of analysis can enable public health authorities to respond more effectively to emerging threats.

AI can be particularly useful in behavioural epidemiology, in which data from mobile apps and social media can be analysed to track health behaviours, such as diet, physical activity, and mobility. AI can also evaluate the impact of interventions designed to change these behaviours[8] and model the trade-offs involved.[9] These insights can then be linked to disease prevalence, providing a holistic understanding of the factors contributing to public health issues. Machine learning algorithms have been used to extract people's sentiments and beliefs from social media interactions,[10] an approach that has found several mental health applications.[11] Another example comes from the field of environmental health, in which AI-powered tools use machine learning to monitor air quality in urban areas.[12]

AI can also help optimise resource allocation. During the COVID-19 vaccination campaigns, AI models analysed demographic data, health records, and geographical information to establish the best locations for vaccination sites.[13]

AI plays an increasingly important part in public health communication by improving the tailoring of messages to specific populations. AI tools can segment populations on the basis of demographic and behavioural data (eg, through the use of k-means clustering and lasso regression)[14] to increase the likelihood that health messages are culturally appropriate and accessible. AI can also assist in crafting public health messages in multiple languages and at various health literacy levels and can help identify misinformation.[15]

AI-driven chatbots offer a new means of communicating health-related messages. During the COVID-19 pandemic, WHO used AI-powered chatbots on platforms such as WhatsApp to provide real-time information on the virus, including guidance on symptoms, prevention measures, and vaccination.[16] A recent review[17] concluded that chatbots, by providing instant responses, can help to dispel misinformation and guide the public to reliable resources.

Perhaps the most straightforward application of AI is in automating routine tasks, such as generating standard letters or any task that entails summarising large amounts of information (eg, regulations, guidelines, or scientific reports) to produce concise summaries or recommendations. This type of application can substantially reduce the administrative burden on public health professionals, allowing them to focus on strategic tasks such as policy development and programme implementation.[2,3,6]

Challenges in implementing AI in public health

Although AI's potential in public health is considerable, there are notable challenges to its widespread adoption. One of the most important considerations is ensuring that AI is used equitably. AI models are often prone to bias, particularly if they are trained on non-representative datasets.[18] This bias can exacerbate existing health disparities, particularly affecting marginalised and disadvantaged communities.[18] AI systems must be developed with an equity lens that ensures diverse populations are adequately represented in training data. Developers and users must also be aware of issues such as dual valence (whereby a factor that serves as a marker of disadvantage or stigmatisation, such as a postcode, is included in the algorithm) and automation bias (whereby AI-generated decisions are privileged over the wishes of the individuals affected).[19] Bias and equity are distinct concerns in algorithmic decision making, as bias pertains to the fairness of the prediction algorithm itself, ensuring that prediction errors are not systematically related to specific individual characteristics, whereas equity addresses justice in the allocation principles that govern how outcomes are distributed among individuals on the basis of broader ethical considerations.[20] Preferences for what constitutes a so-called fair algorithm can vary substantially among stakeholders, who might value different fairness metrics, reflecting diverse ethical principles.[21]

Individuals making use of AI must trust it sufficiently to use it but not so much that they do not challenge it when results appear to be wrong. This concern has stimulated the emergence of explainable AI, or XAI, in which algorithms explain how they have reached their decisions and what would be needed for them to reach different ones. Although attractive in theory, XAI is not a perfect solution because it does not fully eliminate the risks of false confirmation, when both humans and AI agree on an incorrect decision.[22]

Data privacy is crucial when implementing AI in public health, especially as AI systems often rely on integrating data from multiple sources. Combining personal health data with other datasets increases the risk of reidentification and stigmatisation. Increasing reliance on these systems and the amount and scope of data they hold make them attractive targets for individuals seeking to extract ransoms or steal data.[1] This threat calls for robust controls on data access and investment in cybersecurity.

When AI is entrusted to perform particular tasks, humans must ensure the technology has been developed and used appropriately.[1] This assurance means having a so-called human in the loop, ensuring the active participation of users (ie, health professionals, patients, or citizens) at all stages from algorithm development, when humans are involved in designing, testing, and refining the model, ensuring it aligns with ethical and technical standards, onwards. At the implementation stage, the human role shifts to oversight, monitoring how the algorithm operates in real-world scenarios and avoiding unforeseen issues such as bias or errors. In day-to-day use, human involvement is required to ensure control, with AI acting as a supportive tool. Clear lines of accountability are also needed should anything go wrong.

Many public health institutions still rely on outdated health information systems that are not equipped to handle the large-scale data analysis that AI requires. Upgrading these systems and improving data-sharing mechanisms are essential steps for successfully integrating AI into public health. A 2023 survey on digital health in the WHO European region found that a little over half of countries reported having a unified interoperability strategy for secure information sharing across the health system, whereas only a third had a specific policy on using big data and advanced analytics in the health sector.[23]

The public health workforce often does not have the skills needed to use AI tools effectively. Although training materials are available,[24] the pace of change in AI creates a need for regular updating and existing demands on the public health workforce leave little time

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for training. In the aforementioned 2023 WHO survey,[23] roughly half of countries reported having already developed digital health education action plans, policies, or strategies. AI is also included in the work of a Digital Public Health Taskforce established by the Association of Schools of Public Health in the European Region.[25]

Implications for policy

Robust regulatory frameworks are essential to leverage the potential of AI for public health while also encouraging innovation. WHO has set out principles for developing such frameworks.[26] They cover pre-market assurance, performance monitoring, documentation, and transparency. They stress the importance of continuous documentation of the system's lifecycle to ensure transparency and traceability, describe validation methods and risk management, and emphasise the importance of engagement with stakeholders.[27]

Within the EU, the regulatory framework centres around the 2024 Artificial Intelligence Act.[28] It seeks to ensure AI is trustworthy, establishing a risk-based approach with different requirements and obligations for different types of AI systems. The AI Act[28] protects fundamental rights, prohibiting AI systems that pose an unacceptable risk, such as those that score people on the basis of criteria such as their perceived contribution to society, and places restrictions on high-risk AI systems.[29] It also seeks to encourage the uptake of AI and reduce administrative and financial burdens for businesses, although complying with its requirements will inevitably place greater burdens on small and medium enterprises. Use of AI within the EU is also subject to the Medical Device Regulation, General Data Protection Regulation, and planned European Health Data Space Regulation.

Although a robust regulatory framework is essential, there is also a need to ensure that appropriate ethical safeguards are in place. WHO has set out a series of ethical principles that should inform the use of AI in ways that respect human rights and promote the common good,[1] accompanied by guidance on specific topics.[30] These principles draw on a growing body of research on using different tools, such as large language models.[31] The Council of Europe has also drawn up a framework convention to ensure that activities within the lifecycle of AI systems are fully consistent with human rights, democracy, and the rule of law, while also being conducive to technological progress and innovation.[32] Other actors involved in public health must lead by example in promoting the responsible and scalable use of AI. For example, Gavi, the Vaccine Alliance, has developed guidance on the use of AI in vaccination programmes.[33]

Although public health institutions have a role in shaping data governance frameworks that ensure accountability and transparency while maximising the potential of data and AI to promote public good, this goal will require sustained investment in data infrastructures, with particular attention to access, interoperability, and security, and will only be possible if there are trusted strategic partnerships among governments, academia, and the private sector. This work might be threatened in areas in which commercial providers have attracted controversy.[34]

Considerations for public health institutions

Public health institutions (including public health agencies) cannot ignore developments in AI. Yet many stakeholders, including public health institutions and health ministries, can feel overwhelmed and unclear about actions to prioritise.

First, public health institutions must ensure that their staff are familiar with relevant legal and regulatory frameworks and principles that guide the use of AI. Their approach should be dynamic and adaptable to the evolving landscape of AI technology. Second, public health institutions should think about how to prioritise equity in AI design and implementation, minimising the risk of reinforcing existing health disparities. Training datasets must be inclusive and representative of diverse populations. Explainable AI technologies might help ensure decisions made by AI systems are understandable and fair, helping build accountability. Prainsack and Kickbusch[35] advocate for three pillars of "data solidarity": making data use easier when there are large potential benefits; prohibiting uses that pose high risks; and sharing benefits among those who supply data and those who consume it. Third, they must invest in systems that can securely process the large volumes of data needed for AI applications. Many public health institutions still rely on outdated information technology systems, which limit their ability to do so. Fourth, public health institutions must invest in training public health professionals in the appropriate use of AI technologies and ideally recruit and retain a dedicated workforce that can work confidently across both domains (an example of what this could look like is the approach of the Artificial Intelligence Centre for Public Health Research at Germany's national public health institute, the Robert Koch Institute).[36] Fifth, special attention must be given to data governance and cybersecurity. Systems should already be in place to protect against risks such as reidentification or misuse of personal health information, but these should be reviewed, taking what is possible with AI into consideration. Investing in robust cybersecurity measures is essential to safeguard against data breaches and unauthorised access, which could undermine public confidence in AI applications. Sixth, promoting the ethical use of AI through clear guidelines that align with human rights and the public good is important. Public health institutions should engage a wide range of stakeholders in discussions about AI's role in their work. This participatory approach will help ensure that AI is used responsibly and that its benefits are distributed equitably, fostering greater public trust. Finally, given their role in promoting planetary health, public health institutions have a particular role in highlighting AI's environmental impact.[37] This responsibility also entails carefully considering when and how to use AI for the different tasks discussed above.

Conclusion

If they are to implement these considerations, public health institutions will have to undergo substantial structural, organisational, and cultural transformations. These will include establishing robust digital infrastructures capable of handling large-scale data and ensuring interoperability across systems. Organisations must invest in workforce development—recruiting AI and data analytics experts while still providing ongoing training to equip public health staff with the skills needed to use AI tools effectively. Cross-sector networks and partnerships are essential to facilitate knowledge sharing and promote best practices, allowing institutions to learn from successful implementations of AI in public health globally. Additionally, public health institutions must prioritise equity and ethics with datasets that include diverse populations, the adoption of explainable AI technologies, and engagement with stakeholders in participatory decision-making processes.

Contributors

DP, KA, SB, NA-M, and MMcK conceptualised the content of this Viewpoint. DP and MMcK were responsible for the literature review and the drafting and revising of the manuscript. KA, SB, FG-d-S, KL, NA-M, JF, and DN-O contributed to the concept of this Viewpoint and the review and revision of the manuscript. All authors agreed on the final draft.

Declaration of interests

DP, KA, SB, KL, NA-M, JF, and MMcK declare coverage of travel costs through EU-funded projects or other non-profit organisations to attend conferences and speak at meetings (no personal fees). DP, KA, NA-M, DN-O, and JF are employed by WHO, whereas SB and FG-d-S have had a technical consultancy contract with the same organisation. KL declares financial support from the German Ministries of Health and Education and Research to the Robert Koch Institute, where she is employed. The authors affiliated with WHO are solely responsible for the views expressed in this Viewpoint; they do not necessarily represent the decisions or policies of WHO.

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References

1 WHO. Ethics and governance of artificial intelligence for health. World Health Organization, 2021. https://www.who.int/publications/i/item/9789240029200 (accessed Oct 18, 2024).

2 Bharel M, Auerbach J, Nguyen V, DeSalvo KB. Transforming public health practice with generative artificial intelligence. *Health Aff* 2024; **43:** 776–82.

3 Fisher S, Rosella LC. Priorities for successful use of artificial intelligence by public health organizations: a literature review. *BMC Public Health* 2022; **22:** 2146.

4 Panch T, Pearson-Stuttard J, Greaves F, Atun R. Artificial intelligence: opportunities and risks for public health. *Lancet Digit Health* 2019; **1:** e13–14.

5 Pan American Health Organization. Artificial intelligence in public health. Pan American Health Organization, 2021. https://iris.paho.org/handle/10665.2/53732 (accessed Oct 18, 2024).

6 McKee M, Rosenbacke R, Stuckler D. The power of AI for managing pandemics: a primer for public health professionals. *Int J Health Plann Manage* 2025; **40:** 257–70.

7 Olawade DB, Wada OJ, David-Olawade AC, Kunonga E, Abaire O, Ling J. Using artificial intelligence to improve public health: a narrative review. *Front Public Health* 2023; **11:** 1196397.

8 Mac Aonghusa P, Michie S. Artificial intelligence and behavioral science through the looking glass: challenges for real-world application. *Ann Behav Med* 2020; **54:** 942–47.

9 Dignum F, Dignum V, Davidsson P, et al. Analysing the combined health, social and economic impacts of the corovanvirus pandemic using agent-based social simulation. *Minds Mach* 2020; **30:** 177–94.

10 Wang S, Liang C, Gao Y, et al. Social media insights into spatio-temporal emotional responses to COVID-19 crisis. *Health Place* 2024; **85:** 103174.

11 Saha K, Yousuf A, Boyd RL, Pennebaker JW, De Choudhury M. Social media discussions predict mental health consultations on college campuses. *Sci Rep* 2022; **12:** 123.

12 Airly. About Airly. Airly, 2024. https://airly.org/en/about-airly/ (accessed Oct 18, 2024).

13 Mellado B, Wu J, Kong JD, et al. Leveraging artificial intelligence and big data to optimize COVID-19 clinical public health and vaccination roll-out strategies in Africa. *Int J Environ Res Public Health* 2021; **18:** 7890.

14 Bashingwa JJH, Mohan D, Chamberlain S, et al. Can we design the next generation of digital health communication programs by leveraging the power of artificial intelligence to segment target audiences, bolster impact and deliver differentiated services? A machine learning analysis of survey data from rural India. *BMJ Open* 2023; **13:** e063354.

15 Lu J, Zhang H, Xiao Y, Wang Y. An environmental uncertainty perception framework for misinformation detection and spread prediction in the COVID-19 pandemic: artificial intelligence approach. *JMIR AI* 2024; **3:** e47240.

16 WHO. Chatbots against COVID-19: using chatbots to answer questions on COVID-19 in the user's language. World Health Organization, 2022. https://www.who.int/news-room/feature-stories/detail/scicom-compilation-chatbot (accessed Oct 18, 2024).

17 Cosma C, Radi A, Cattano R, et al. Exploring chatbot contributions to enhancing vaccine literacy and uptake: a scoping review of the literature. *Vaccine* 2025; **44:** 126559.

18 McKee M, Wouters OJ. The challenges of regulating artificial intelligence in healthcare comment on "Clinical Decision Support and New Regulatory Frameworks for Medical Devices: Are We Ready for It? - A Viewpoint Paper". *Int J Health Policy Manag* 2023; **12:** 7261.

19 Pot M, Kieusseyan N, Prainsack B. Not all biases are bad: equitable and inequitable biases in machine learning and radiology. *Insights Imaging* 2021; **12:** 13.

20 Kuppler M, Kern C, Bach RL, Kreuter F. From fair predictions to just decisions? Conceptualizing algorithmic fairness and distributive justice in the context of data-driven decision-making. *Front Sociol* 2022; **7:** 883999.

21 Näher AF, Krumpal I, Antão EM, et al. Measuring fairness preferences is important for artificial intelligence in health care. *Lancet Digit Health* 2024; **6:** e302–04.

22 Rosenbacke R, Melhus Å, McKee M, Stuckler D. AI and XAI second opinion: the danger of false confirmation in human-AI collaboration. *J Med Ethics* 2024; published online July 19. https://doi.org/10.1136/jme-2024-110074.

23 WHO. Digital health in the WHO European region: the ongoing journey to commitment and transformation. World Health Organization, 2023. https://www.who.int/europe/publications/i/item/9789289060226 (accessed Oct 18, 2024).

24 WHO. Generating evidence for artificial intelligence based medical devices: a framework for training validation and evaluation. World Health Organization, 2024. https://www.who.int/publications/i/item/9789240038462 (accessed Oct 18, 2024).

25 ASPHER. Digital public health task force. ASPHER, 2024. https://www.aspher.org/digital-public-health-task-force.html (accessed Oct 18, 2024).

26 WHO. Regulatory considerations on artificial intelligence for health. World Health Organization, 2023. https://iris.who.int/handle/10665/373421 (accessed Oct 18, 2024).

27 Hattab G, Irrgang C, Körber N, Kühnert D, Ladewig K. The way forward to embrace artificial intelligence in public health. *Am J Public Health* 2025; **115:** 123–28.

28 European Commission. AI act. European Commission, 2024. https://digital-strategy.ec.europa.eu/en/policies/regulatory-framework-ai (accessed Oct 18, 2024).

29 Schmidt J, Schutte NM, Buttigieg S, et al. Mapping the regulatory landscape for artificial intelligence in health within the European Union. *NPJ Digit Med* 2024; **7:** 229.

30 WHO. Ethics and governance of artificial intelligence for health. Guidance on large multi-modal models. World Health Organization, 2024. https://www.who.int/publications/i/item/9789240084759 (accessed Oct 18, 2024).

31 Chen H, Fang Z, Singla Y, Dredze M. Benchmarking large language models on answering and explaining challenging medical questions. *arXiv* 2024; published online June 25. https://doi.org/10.48550/arXiv.2402.18060 (preprint).

32 Council of Europe. The Framework Convention on Artificial Intelligence. Council of Europe, 2022. https://www.coe.int/en/web/artificial-intelligence/the-framework-convention-on-artificial-intelligence (accessed Oct 18, 2024).

33 Chukwu E, Layer E, Mechael P. Gavi digital health information to digital health strategy: artificial intelligence & machine learning for immunisation. Gavi, the Vaccine Alliance, 2024. https://www.gavi.org/sites/default/files/programmes-impact/our-impact/Technical-Brief-AI-Machine-Learning.pdf (accessed Oct 19, 2024).

34 Thornton J. Palantir NHS contract raises criticisms. *Lancet* 2023; **402:** 2060.

35 Prainsack B, Kickbusch I. A new public health approach to data: why we need data solidarity. *BMJ* 2024; **386:** q2076.

36 Robert Koch Institute, Centre for Artificial Intelligence in Public Health Research (ZKI-PH). The doctoral programme AI in Public Health. Robert Koch Institute, 2024. https://www.rki.de/EN/Content/Institute/DepartmentsUnits/ZKI-PH/doctoral-programme-AI-in-public-health.html (accessed Jan 28, 2025).

37 Dhar P. The carbon impact of artificial intelligence. *Nat Mach Intell* 2020; **2:** 423–25.