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DOI: 10.1377/hlthaff.2024.00050
HEALTH AFFAIRS 43, NO. 6 (2024): 776–782


COMMENTARY

# Transforming Public Health Practice With Generative Artificial Intelligence

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**ABSTRACT Public health practice appears poised to undergo a transformative shift as a result of the latest advancements in artificial intelligence (AI). These changes will usher in a new era of public health, charged with responding to deficiencies identified during the COVID-19 pandemic and managing investments required to meet the health needs of the twenty-first century. In this Commentary, we explore how AI is being used in public health, and we describe the advanced capabilities of generative AI models capable of producing synthetic content such as images, videos, audio, text, and other digital content. Viewing the use of AI from the perspective of health departments in the United States, we examine how this new technology can support core public health functions with a focus on near-term opportunities to improve communication, optimize organizational performance, and generate novel insights to drive decision making. Finally, we review the challenges and risks associated with these technologies, offering suggestions for health officials to harness the new tools to accomplish public health goals.**

Public health is what a nation does together as a society to create and ensure the conditions in which everyone can be healthy.[1] Periodically, circumstances call for a dramatic shift in the ways in which optimal health is promoted. Several years ago, coinciding with a renewed focus on the social and environmental determinants of health, a shift occurred to expand traditional public health agency programs to institutionalize greater cross-sector collaboration and communitywide approaches to reach whole populations and address health inequities.[2] Emerging around this time, the Public Health 3.0 framework was intended to expand the scope of practice for public health.[1,3] One important dimension of this framework calls on the public and private sectors to work together to make real-time, geographically granular data more widely available.[3] Although the field has been evolving toward a 3.0 model, using data-driven approaches to improve health outcomes, the COVID-19 pandemic revealed the need to upgrade data systems and other technological capabilities, compelling public health to evolve even further.

More specifically, to fully realize Public Health 3.0, public health departments need to explore ways to integrate technology and new generative artificial intelligence (AI) capabilities that have garnered public attention during the past two years. We believe that generative AI will provide transformative opportunities for public health officials to approach their work. In this Commentary, we explore current uses for AI and examine the advanced capabilities of generative AI, demonstrating how they can serve as a catalyst for advancing public health. We discuss ways in which generative AI can support public health practice, including core workflows, recognizing

that new technologies are most effective when they can help staff members even in the smallest local health departments. Finally, we review the challenges and risks associated with these new technologies.

The emergence of new AI tools comes at a pivotal moment as those in the governmental public health sector are revamping their data systems based on lessons learned from the COVID-19 pandemic. There is an opportunity for public health to use technology in ways that support innovation and contribute to improved organizational systems and processes to improve health outcomes.[4] This Commentary is not intended to be a comprehensive review of the current uses of generative AI in public health but, rather, a framework for outlining how public health professionals might begin to use generative AI to accomplish public health goals.

## AI Technology: Key Concepts And Recent Developments

Public health officials must become fluent in the language of AI. As it becomes more visible, we foresee public-sector leaders asking how AI can be used in governmental public health, along with health care and public health agencies seeking opportunities to collaborate, health department employees voicing both their hopes and their concerns related to the new technology, and the general public wanting to understand how their data are being protected. To communicate with these diverse audiences, public health leaders will need to adopt a common vocabulary and understand core concepts related to AI, including some basic terms.

**ARTIFICIAL INTELLIGENCE** The term *artificial intelligence* describes the computer systems able to perform tasks that normally require human intelligence. In daily conversation, AI can carry many meanings depending on the context and the speaker. Formally, AI is a "machine-based system that can, for a given set of human-defined objectives, make predictions, recommendations, or decisions influencing real or virtual environments."[5] AI systems analyze and translate machine- and human-based inputs into models to formulate potential options for information or action.[5]

**MACHINE LEARNING** Machine learning encompasses "a set of techniques that can be used to train AI algorithms to improve performance at a task based on data."[5] This subset of AI enables computers to learn from data inputs without being specifically programmed.

**GENERATIVE ARTIFICIAL INTELLIGENCE** The term *generative AI* represents "the class of AI models that emulate the structure and characteristics of input data in order to generate derived synthetic content. This can include images, videos, audio, text, and other digital content."[5] These newer AI models can create original content such as sentences, stories, images, and music.

**LARGE LANGUAGE MODELS** Large language models are a type of generative AI focused on language-based tasks. These models are trained on large volumes of text and can be used to generate plausible language, create summaries, perform question answering, or provide text classification.[6] Large language models function as "next-word prediction engines" that can serve as augmentation tools, enhancing human capability with AI-powered technology.[7]

## Current Application Of AI In Public Health

The uptake of AI technology has varied by sector. The academic field of AI has existed since the 1950s, with AI tools being incorporated into health care for individual patients and health system populations over time.[8] In fact, the health care system is already exploring the use of generative AI in health care administration and delivery, such as electronic medical record search and summarization capacities.[9–11] However, innovations in health care cannot be directly applied to public health because addressing health at the population level will require specific innovations in public health systems. In public health, the use of AI and generative AI is much less common, but there is abundant opportunity for innovation. Literature reviews catalog the uses of nongenerative AI in public health,[12] and here we provide a few salient examples. The widespread adoption of AI technologies in public health remains a challenge, however, because of limited resources and the challenge of recruiting and training a workforce skilled in these technologies and their application to public health arenas.[13]

As an example of nongenerative AI use, computer vision models have used aerial imagery to identify cooling towers to help with outbreak investigations of Legionnaires' disease.[14] Natural language processing has been used to extract unstructured text from a variety of reports to enhance surveillance systems, inform disease prevention strategies, and support health promotion.[15] For example, researchers found a high correlation between Twitter posts related to influenza symptoms and the influenza-like illness identified by traditional surveillance systems.[16] Public health–focused AI projects have also been used to contribute to public health research[17] and to inform infectious disease outbreak detection,

trend prediction, and public health modeling.[18]

Among many lessons, the COVID-19 pandemic broadly exposed deficiencies in the US public health information technology infrastructure and its ability to share information.[19] Counterintuitively, the inability of existing technologies to respond to the pandemic stimulated a period of rapid innovation in AI-powered public health solutions.[20,21] Computer scientists who had not previously worked in public health brought AI tools such as neural networks and novel data sets together to build COVID-19 forecast models.[22] These tools have the potential to be used in many aspects of health, including infectious disease surveillance, chronic disease management, health equity, and access to services such as mental health services.

## Core Capabilities Of Public Health And The Emerging Role Of Generative AI

The Foundational Public Health Services framework outlines a set of core functions and capabilities for US public health agencies.[23] The eight capabilities were developed in 2013 to define minimum requirements for all jurisdictions and were updated in 2022 to integrate lessons learned from the COVID-19 pandemic, including the centrality of combating health disparities. The new framework emphasizes the importance of equity, data technology, social determinants of health, and the public health workforce.[23] Generative AI has the potential to enhance the ability of public health agencies to provide these core services more effectively.

Integration of new technologies into any profession is best accomplished when the technology helps the workforce in completing important daily tasks. This is no different for generative AI, and generative AI is well positioned to support three Foundational Public Health Services capabilities: communications, organizational competencies, and assessment and surveillance. More specifically, generative AI models can assist in developing evidence-based communication that meets the health literacy and language needs of diverse populations, thereby making public health services more accessible for all; increasing organizational performance by reducing clerical burden on staff; and generating novel insights from newly accessible data sources to assess community needs and programmatic outcomes. These three applications for generative AI can help public health officials understand and incorporate new technologies into day-to-day workflows.

**Generative AI can facilitate advanced analytics to inform new interventions to address complex health issues.**

## Three Applications For Generative AI Models In Public Health

We suggest a framework to begin to use generative AI in public health settings in three specific areas. Each of these includes keeping a human "in the loop" to ensure safety and accuracy. Gaining experience in generative AI in public health will allow for the cocreation of new applications that drive innovation and equity in health.

**PUBLIC COMMUNICATION** Governmental public health plays an important role in educating and informing the public about health issues, including health promotion, risks, emergencies, health care, and access to benefits. Extensive resources are spent ensuring that authoritative, high-quality information is available on multiple platforms, presented in different languages and literacy levels. The need to engage constituents through a variety of distribution channels has only increased in recent years with the waxing and waning of preferred social media platforms among different segments of the population. Real-world capacity constraints make it impossible to effectively meet the diverse information needs of constituents across every communication channel.

Generative AI has the potential to offer a more personalized experience. Some experts have argued for the importance of precision public health, and generative AI will provide tools to meet the specific information needs of individuals and the public at large.[24] Generative AI tools can more easily create materials at multiple literacy levels and in a range of languages spoken by communities. Materials can also be personalized to suit different geographic locations and cultural factors. Content can be shared across multiple media formats, including text, audio, and images. Image generators such as Image FX and DALL-E use language prompts to generate images.[25,26] These could be used by public health

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officials to rapidly produce visuals to aid communication efforts.

For instance, COVID-19-era images depicting social distancing, washing hands, and wearing a face mask are ingrained in the minds of billions of people around the world, crossing all international boundaries. These images were, arguably, more universally effective at communicating important health information than text or speeches in specific languages. With text-to-image AI image generators, the barrier to creating and testing visual resources has fallen dramatically for the average health department.

In addition, generative AI has the potential to summarize health information into easy-to-understand formats so that residents can get answers to their specific questions more effectively and efficiently. Instead of clicking across a public health website to answer complex questions or engaging in a complicated exchange of phone tag with staff at the health department, a constituent can simply initiate a conversation within an AI interface and receive factually grounded responses in a more accessible question-and-answer format twenty-four hours a day.

**ORGANIZATIONAL PERFORMANCE** Public health uses a bureaucratic system of checks and balances and public accountability based on specific regulations and laws. This system offers transparency to the public, but it can lead to extensive clerical burden for staff at all levels. Generative AI has the potential to reduce this clerical burden by summarizing and automating administrative tasks, organizing large amounts of data, and providing analytic support to free up valuable time for staff to engage in work at the top of their professional capacity.

For instance, a policy analyst might spend three days reviewing dozens of pages of proposed regulation and hundreds of public comments to summarize information for a board of health vote. In addition to substantial comments, an analyst will need to manually review duplicative, irrelevant, or poorly written comments, which is a tedious and frustrating task that can be prone to human error. Generative AI tools based on large language models can empower the analyst by searching, extracting, and summarizing information found within large amounts of written text. Removing this clerical burden will allow the analyst to spend more time reviewing the computer-generated summary; analyzing previous health policy proposals; and designing a more thoughtful, strategic recommendation to leadership.

Generative AI tools can also enhance grant, policy, and report writing by creating drafts that summarize large amounts of background material and transform rough notes into coherent paragraphs. Natural-language-to-code capabilities can make data analysis more efficient for both technical and nontechnical staff. Generative AI coding tools help technical team members write code more quickly and allow nontechnical staff to extract and organize data for reporting requirements using text prompts.

**NOVEL INSIGHTS** Public health professionals need to assess emerging trends and programmatic outcomes to inform public policies and interventions. Generative AI tools can augment the ability to collect and analyze large amounts of data related to health, including information in the form of unstructured free text. There is often not enough capacity to fully organize and analyze these data because of constraints on time, personnel, and expertise.

Generative AI can facilitate advanced analytics to inform new interventions to address complex health issues. For example, unstructured notes on medical examiners' case reports, social media activity, and news reports are all potential useful text signals that are currently inaccessible at a population level. New multimodal models are emerging that will be able to integrate additional data modalities such as imaging, genomics, environmental, and geographic data into models.[27] Generative AI can make these data types available to increase understanding of health in novel ways and through new analytic techniques.

Taken together, these applications have the potential to revolutionize public health by making it easier to communicate with the public, increase organizational performance, and generate novel insights into complex health problems.

## Challenges Of Generative AI In Public Health

The potential benefits of generative AI for public health are significant and exciting. Many scholars, however, have commented on the risks and

challenges for society and specific industries.[28,29] Important themes across these discussions include explainability, inaccurate results ("hallucinations"), ethics, exacerbating inequalities, workforce disruption, and regulatory risk. For public health officials, challenges can be categorized into three important domains: public trust, health equity and ethics, and workforce implementation.

**PUBLIC TRUST** One of the most important lessons reinforced during the COVID-19 pandemic is that high trust in government was significantly associated with greater adoption of health-promoting behaviors.[30] Ensuring that new generative AI models enhance and do not degrade public trust will be important as new tools are adopted. Authorities will need to be transparent about data used to train AI; how insights gleaned from AI may inform action; and the creation of safety, security, and privacy standards. Generative AI models are only as good as the data they are trained on. If data quality is poor, it can lead to outputs that are inconsistent, unreliable, or biased. Inaccurate outputs will erode public trust, so public health entities will need to take a leadership role in ensuring that models are grounded with privacy-preserving, high-quality data.

**HEALTH EQUITY AND ETHICS** Officials must also ensure that equity is prioritized during all stages of model development and production, to address potential biases. Data sets should be checked for proper coverage of historically marginalized groups. Models should be grounded with high-quality, authoritative content and should include systematic checks for bias, such as quality and safety adjudication systems that rely on experts from diverse backgrounds. Outcomes need to be assessed for bias during pilot testing, and this should continue throughout real-world implementation. Many have recommended that a comprehensive approach to equity during the entire development and deployment process is needed to balance innovation and equity.[31,32] In addition, model development should adhere to an ethical framework to facilitate the safe and responsible use of these new technologies.[33,34]

**WORKFORCE IMPLEMENTATION** Implementing new technologies can be disruptive for any organization, and generative AI is no exception. This technology will not replace public health officials. Instead, a public health official who can fully use the capabilities of generative AI models will be more effective than an official without these skills. Humans in the loop are needed to ensure accurate analysis and appropriate interpretation of results. Training programs are needed to upskill existing workers, and curricula need to be adjusted to prepare students who will enter the public health workforce. Senior leadership will need to identify generative AI use cases that create the greatest public value and make investments into people, processes, and technology. Regulatory frameworks for AI are actively evolving, and officials will need to understand the risks and benefits of generative AI to advocate for rules that maximize the public's health.

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## Conclusion

Public health has the potential to rapidly evolve with the advent of new technologies. But ultimately, AI, including generative AI, is just a tool, similar to a vaccine or genomic surveillance. Public health practitioners will need to master the new tools and learn to use them as part of a larger public health strategy. In this discussion, we reviewed the use of AI and presented three early use cases for generative AI related to communications, organizational performance, and generating novel insights that align with three of the eight core capabilities defined in the Foundational Public Health Services framework.[23] We hope that these examples will help public health officials understand how generative AI can be used to benefit their communities.

There will be challenges with the adoption of generative AI related to maintaining public trust, ensuring health equity and ethical behavior, and implementing new technologies across the workforce. Resolving these issues will require partnerships across academic institutions, government, community, and technology companies for public health to understand and adopt these innovative solutions. Public Health 3.0 highlighted the need for actionable data.[1,3] Public health can use AI to build on the progress of previous public health advancements. In doing

so, it is also important that public health not fall further behind as technologies advance, widening the innovation gap vis-à-vis other sectors of the economy. Public health should embrace these technological advancements and support new innovation to improve health opportunities for all. ■

The authors thank the following people for their review of the manuscript: Michael Howell, Justin Kerr, Perry Payne, and Susan Thomas. Monica Bharel and Von Nguyen are employees of Google. John Auerbach is an employee of ICF. Karen B. DeSalvo is an employee of Google, a member of the board of directors for Welltower, and a former director on the Humana board. 

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