

Artificial Intelligence in Public Health

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What are the **guiding principles** for the use of Artificial Intelligence for Public Health (AI4PH) interventions?

The use of Artificial Intelligence (AI) in public health must be guided by superior technical and ethical considerations aimed to mitigate ethical risk in public health and related policy interventions, reflected in the following eight guiding principles:

People-centered. Actions and solutions must be people centered and not be used solely by itself. As one of many technologies to aid public health AI should respect the rights of the individual.

Ethically grounded. Discussions, developments, and implementation must be grounded in the globally-agreed ethical principles of human dignity, beneficence, non-maleficence and justice.

Transparent. Transparent approaches must always be used and communicated when developing AI algorithms.

Data protected. Privacy, confidentiality, and security of data use must be foundational to every AI development.

Demonstrates scientific integrity. AI interventions should follow scientific best practice including being reliable, reproducible, fair, honest, and accountable.

Open and sharable. Everything must be as open and sharable as possible. Tools and underlying concept of Openness ¹ must be a feature and a critical success factor of any AI development.

Non-discriminatory. Fairness, equality and inclusiveness in impact and design should always form the foundation of any AI initiative for Public Health.

Human-controlled technology. Formal processes for human control and review of automated decisions are mandatory.

The main consideration in the development, deployment, or utilization of AI for public health must be patient safety and quality of care, always supported by evidence.

What are some of the **components and subfields of AI** that can benefit Public Health?

- ✓ **Machine learning:** process of applying training-data to a “learning algorithm.” The algorithm
- ✓ generates a set of rules, based on identified data patterns. These rules can then be used to classify new data or predict future data. By using different training-data, the same learning algorithm could be used to generate different models, e.g. pathology prediction etc.

¹ Openness concept refers to: Open Access, Open Data, Open Standards, Open Source, Open Access, Open Government, Open Science, Open Maps, Open Knowledge and Open Content for Education always

- ✓ **Cognitive search:** The use of AI solutions (such as machine learning and NLP) to incorporate and understand digital content from many different types of sources, such as text, images, video and machine data. The goal is to improve the relevance of the results generated from a user search.
- ✓ **Natural language processing (NLP):** NLP automates the ability to read, understand, and derive meaning from human language. Two NLP subfields of particular interest are described below.
 - **Natural language understanding (NLU):** Algorithms designed to understand human writings using a coded understanding of grammar, syntax and semantics.
 - **Natural language generation (NLG):** Algorithms designed to automatically transform structured data into plain language. It is considered the opposite of NLU.
- ✓ **Robotics:** An interdisciplinary research area at the interface of computer science and engineering. The goal of robotics is to design intelligent machines that can assist human activity.
- ✓ **Virtual agents (chatbots):** Also known as “conversational agents”. These are software applications that mimic written or spoken human speech to simulate a conversation or interaction with a real person.
- ✓ **Computer vision:** Training computers to interpret and understand the visual world. Using digital images from cameras and videos and deep-learning methods. Machines can accurately identify and classify objects.
- ✓ **Deep learning:** A subfield of machine learning that uses algorithms designed as networks of decisions to learn from data. These networks are often called neural networks. When there are many layers in the network, they are called deep neural networks or deep learning network. Deep learning can identify diseases based on imaging and can predict health status from electronic health records.
- ✓ **Speech analytics:** The process of analyzing live or recorded speech to understand and derive meaning.

To minimize bias, the same standard of evidence used for other clinical and public health interventions must be applied to AI4PH. Limitations must be transparently clearly stated and have the ability to be externally assessed.

How AI is being used in Public Health?

Component / Subfield	Uses of AI in Public Health	References
Machine Learning	Data Science and Machine Learning in Public Health: Promises and Challenges Understanding complex connections between genetics, environment and disease	USA CDC Blog Nature Genetics
Natural Language Processing (NLP)	Behavior analysis through the social media and consumer-generated data	Yearbook of Medical Informatics
Natural Language Understanding (NLU)	Prediction of Loneliness in Older Adults	The American Journal of Geriatric Psychiatry
Natural Language Generation (NLG)	Removing identifiers from electronic health records data	Digital Medicine - Nature
Cognitive Search	Search Engine to Evaluate and Analyze Information About COVID-19	Microsoft, Allen Institute For AI
Digital decisioning platforms	Decision-making through modeling and understanding of multiple variables and complex systems	Llama.ai
Robotic	Disinfection of areas, Delivery of medications & food, Measuring of vital signs in the COVID-19 environment	Science Robotics
Virtual Agents (Chatbots)	Healthy Lifestyle/Wellness, Mental Health, Reproductive Health, Weight Control and Smoking Cessation	Studies in Health Technology
Computer Vision	Medical imaging and predictive modelling for pulmonary medicine	European Respiratory Review
Deep Learning	Deep Learning Algorithm for Detection of Diabetic Retinopathy in Retinal Fundus Photographs	The Journal of the American Medical Association
Speech Analytics	Analysis of Human Behavior and States	AI As A Disruptive Technology

What are the main considerations for implementing AI4PH?

The ethical principles of **beneficence**, **non-maleficence**, **autonomy**, and **justice**, along with **human rights** like dignity, respect for life, freedom, health, self-determination, equity, justice, privacy and property must be considered when implementing AI solutions for Public Health.

National and regional regulatory frameworks for AI must uphold both **ethical principles** and **individual rights**. The main areas of legislation that should be considered for applying AI in Public Health are:

- ✓ Data protection, privacy and freedom of information
- ✓ Electronic clinical records regulation
- ✓ Agreements for national (and potentially regional) exchange of health information
- ✓ Health Technology Assessments for AI

The aim of AI4PH is to maximize the benefits for society without compromising the rights of individuals.

How does this relate to the 8 Principles for Digital Transformation of Public Health?

In mid-2020, the United Nations presented eight areas of collaboration based on recommendations from a high-level panel to make technical cooperation operational in the age of digital interdependence. In this regard PAHO has embraced and adapted those areas in eight principles to reflect the imperatives of the Digital Transformation of the Health Sector: 1) Universal connectivity; 2) Digital goods; 3) Inclusive digital health; 4) Interoperability; 5) Human rights; 6) Artificial intelligence; 7) Information security, and, 8) Public health architecture.

Principle 6: Artificial intelligence.

Participation in **global cooperation on artificial intelligence** and any emerging technology should be part of Public Health policies. The principle of global cooperative support in artificial intelligence and any emerging technology means including the individual and social dimensions in a globalized, interconnected reality that is now part of the human condition.



Figure 1: Eight Principles for the Digital Transformation of the Health Sector

Global cooperation in artificial intelligence involves understanding the individual and social dimension in a globalized and interconnected reality that belongs to the human condition. Such cooperation, as well as working in multisectoral and interdisciplinary networks, is vital in designing and adopting artificial intelligence solutions that promote approaches to equity, gender and cultural diversity with secure, reliable and open algorithms.

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