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Chapter 9

The role of artificial intelligence in population health management and public health strategies

Kiran Kumar Maguluri

IT systems Architect, Cigna Plano, Texas, USA.
kirankumar.maguluri.hcare@gmail.com

Abstract

AI plays a vital role in population health management by analyzing large datasets to identify trends, predict health outcomes, and optimize public health strategies. By enabling targeted interventions, resource allocation, and early disease detection, AI enhances public health efforts and improves overall community health and wellness.

Keywords

AI, Disease Prediction, Public Health, Population Health, Resource Allocation, Strategies

9.1. Introduction to Population Health Management and Public Health Strategies

Public health strategy deals with the policies, actions, and methods of practice that aim to improve the health status of individuals, sites, or populations through systematic health and medical care. In essence, the aim of public health is to look into improving the health of the community while providing it with appropriate healthcare. Population health management is a systematic approach for identifying high-risk people or groups who will require regular intervention and, in turn, improve health status and also reduce overall medical expenditures. Both population health management and public health strategies demand special managerial techniques, mostly utilizing AI solutions, for better analytical and predictive insights in managing the healthcare sector through a sound scientific methodology. It is common sense that pragmatic health authorities would prefer to opt for hard-core periodical predictions, maps of diseases, and other planning in controlling the spread of diseases or the effects of related healthcare management (Danda et al., 2023). AI is a bridging tool towards the needed transformation.

The utilization of AI in healthcare often involves the use of software, algorithms, and statistical models to provide quicker and more accurate insights into the population health of an individual as well as of a group. The benefit of AI is that it is not just regulatory but also adaptive and predictive nowadays, producing better results than a solitary public health strategy. Public health is what we as a society do to create and ensure the conditions in which everyone can be healthy. Public health is a larger undertaking and the policy domain for the pursuit of better health. Its scope covers relatively upstream and makes a bigger impact on population health, aligning with larger public policy and politics. Conversely, the term population health management is focused more downstream and is teamed with public health strategy to implement a public health intervention, mostly in smaller communities and conducted at a local level. Hence, it has often been within the realms of practice rather than theory, and the greater healthcare system responds more to other sectors and data rather than to public health or community activity.

9.1.1. Definition and Scope

The terms ‘population health’ and ‘public health’ are often used interchangeably due to their similarities in that they both share the goals of improving and protecting the health of large population groups. While public health strategies involve action at a population or community level, population health management extends to the process of caring for the consumers of healthcare facilities and the larger population by managing resources within the healthcare system. Population health is about maintaining and improving the health and well-being of a community. It includes the management of the health of a group of individuals in a geographic area to promote the well-being of society. Public health is the science of safeguarding the health of the people and consists of three core functions: health improvement including population health, the prevention of disease and injury, and the preparedness for both chronic and emergency conditions.

Population health is a combination of sciences ranging from simple and applied sciences. Together with the uncontrolled aspects of a community, population health is blurred when one or more disciplines focus on the outcomes, the background of human genetics, environment, and therefore, it may be overcome. The outcome in the health sector is certainly and tightly associated with the mutual effects of many factors and not just health services. A comprehensive approach to health in a community called interdisciplinary is needed to achieve and maintain the health of a community over time. Integrating the conjunction of these pre-planned activities and natural and spontaneous events at different levels of the decision-making process will lead to better health outcomes for the community in each country (Syed, 2024). Because of its breadth, intervention, and scope, population health research and strategies can be and mostly are used as a framework for developing public health policies and healthcare intervention programs.

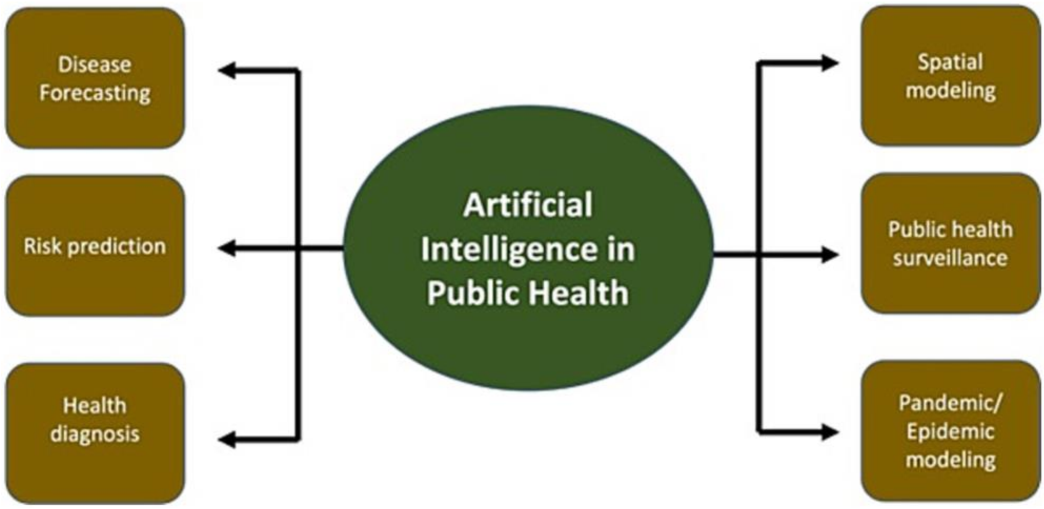

Fig 9 . 1 : Role of AI in Population Health Management.

9.1.2. Importance and Significance

Effective population health management strategies can not only increase individual and collective well-being but also have the potential to systematically tackle various upstream and downstream social determinants of health. These are effective tools that can be used for technological and data-driven real-time responses to pandemics. Failing to apply them more widely can have significant economic ramifications, including increased rates of use in healthcare services and higher healthcare costs. Subsequently, health-related productivity losses are significant and a necessary outcome of overall national workforce capabilities. Furthermore, impaired population health can result in losses to savings and investments, which can lead to impacts on entrepreneurs, small business owners, and entire industries.

Population health management through curative, preventive, and palliative interventions can be beneficial to health and well-being at the community level. Health management encompasses not only a more proactive approach to curing illness and alleviating suffering but also has an impact on a range of areas, including reduced utilization of avoidable acute care services, reduced readmissions, and optimized management of chronic diseases and population health. Population health aims to mitigate health disparities between demographically and socioeconomically diverse patients and improve individual patient satisfaction and well-being. Identified high-risk individuals included members of at-risk populations who, in turn, account for the majority of acute care and medication expenses. Based on information about the range of patients, extra steps are needed. Well-equipped with advanced analytics, reliable instant accrual methods, and superior science, health management companies are especially fit to make extra use of these advanced technologies to assist in the discovery of these individuals. It is for that reason that adding a wide and strong portion into healthcare methods can be an advantage (Nampalli et al., 2024).

Equation 1 : Risk Prediction in Population Health

$$R_{\text{pop}} = \frac{1}{N} \sum_{i=1}^{N} P_{\text{AI}}(Y_i = 1 | X_i)$$

R_{pop}: Average predicted risk in the population.

$P_{\text{AI}}(Y_i = 1 | X_i)$: AI-predicted probability of an adverse health outcome Y_i for individual i based on features X_i.

N: Total population size.

9.2. Fundamentals of Artificial Intelligence in Healthcare

Artificial intelligence (AI) is a branch of computer science that enables the development of computational systems capable of learning, reasoning, and performing tasks. Machine learning is a subset of AI that allows the automated discovery of patterns in large medical data and their application in patient care. From the healthcare provider's perspective, datasets in the healthcare industry are growing significantly. Examples include the exponential growth of the human genome warehouse, electronic health records, and continuous real-time data streams from wearable sensors, transactions, social networks, and the Internet of Things. AI effectively and efficiently processes these large amounts of data for various tasks ranging from drug discovery, clinical diagnosis, and disease personalization to operations improvement and preventive public health outcomes.

AI in healthcare could impact diagnostic accuracy, treatment personalization, operational efficiency, use of scarce resources, and the computer-human interaction needed for decision support in each patient. A recent study estimated that learning outcomes from using deep learning for medical decision-making, among others, could improve by 27% in diagnosing diseases and 45% in predicting patient prognosis/treatment plans. Some studies illustrate how machine learning could address and solve challenges in care. A decision based on a genetic screening of 80,000 patients' whole-exome sequencing, for example, was turned from 40% to 97% accuracy. It can be seen that deep learning uses a medical image more accurately than radiologists. There is evidence that radiologists' systematic cancer computer diagnosis compared to conventional generalist management has a much larger impact on patient outcomes (Mandala et al., 2023).

9.2.1. Overview of AI and Machine Learning

Healthcare is experiencing substantial growth in interest in artificial intelligence (AI). The term AI refers to systems made by humans that can interpret, adapt to, and act in flexible, human-like ways to simulate circumstances even if the system doesn't understand these circumstances. AI systems mimic human cognitive functions such as learning and problem-solving that are typically performed by the human brain. They can involve a type of machine learning, which could be sub-grouped into deep learning and non-deep learning or statistical machine learning. Deep learning is a technique that represents the latest advances in the evolution of AI technologies. It uses numerous layers to transform the raw input into increasingly abstract representations that are used for various tasks such as predictive modeling. All machine learning, including deep learning, involves training a model to perform a specific task using examples from relevant data.

In healthcare, these tasks can range from predicting patient disease outcomes to identifying brain tumors. The context of AI can encompass a wide range of technologies, such as image recognition, instance-based reasoning, semantics, support vector machines, concept mining, and informatics ensembling methods. However, for the purpose of this paper, the term artificial intelligence should be assumed to also include all learning methods, i.e., machine learning. The most well-known form of machine learning is done through neural networks that base their model on the structure and function of the human brain. There are three types of machine learning for the healthcare industry: supervised, unsupervised, and reinforcement. Applications include robotic surgeries, virtual nursing assistants, better treatment and evaluation plans, drug discovery, and virtual organisms that help doctors in diagnosing and providing relevant recommendations. It is anticipated that AI systems are expected to establish a growing influence on modern healthcare delivery and assist healthcare decision-making because of their ability to perform tasks that require human-level capabilities such as logical reasoning, learning from experience, and understanding natural languages, among others.

9.2.2. Applications of AI in Healthcare

Artificial intelligence (AI) has become a buzzword with applications spanning several industries, including healthcare. The transformative power of AI in healthcare has manifested across variously defined segments. AI has made inroads from diagnostics to treatment planning alongside efforts to build automated patient management systems. AI-based tools that define objectives for diagnostics have been developed for medical imaging, eye disease diagnosis from retinal photography, pathology, and genomics.

A number of start-ups and established digital healthcare companies are working on developing AI-driven patient management systems. These applications include a broad range of services such as telemedicine, providing personalized reminders on diet control, medication alerts, and lifestyle advice, tele-diagnostics via chatbots, and safeguarding against wrong prescriptions in case of known allergies. Some AI applications have started with an explicit objective of reducing administrative burden. Services have been launched to automatically route requests from patients to the appropriate non-physician healthcare professionals. Integration of AI applications into healthcare might be challenging, especially if it builds on existing infrastructure; thus, cooperation from healthcare technology vendors will increase feasibility. A much-needed parallel adaptation is to adjust training for health professionals to become literate in the marriage of AI technology and clinical knowledge.

9.3. Integration of AI in Population Health Management

The core of any successful population health management practice and public health intervention is data-driven decision-making. The growing adoption of artificial intelligence opens a wide array of opportunities for health systems to collect and analyze data, even predicting people's health and addressing issues before they become severe medical problems. At the health system's organizational level, AI is expected to construct risk stratification models to identify and target individuals with specific medical conditions, or at risk of developing, which may benefit from more personalized therapies or lifestyle advice. AI will be increasingly adopted for building predictive analytics, which can support patient populations to prevent diseases or slow their evolution (Syed, 2024).

Disease surveillance and outbreak prevention is another public health strategy that benefits from AI contributions, primarily during epidemiological investigations when fast and daily updated data is highly needed. AI's implementation into public health enables the identification of groups, trends, and patterns that are associated with the health issues under investigation. In the epidemiological field, AI applications strive to improve surveillance methods, including claims data reviewed for drug reactions, electronic health record data analyzed for cases relating to national associations, or even search engine data utilized to predict foodborne illnesses. Using sensors or device data, public health professionals could also put into practice innovative interventions, which may rectify some issues before they start. AI integration into public health practices will enhance professionals' ability to define health indicators and risk factors early in their evolution, propose intervention paths that minimize budgets, measure quality, and mitigate health disparities.

Personalized medicine based on data-driven research is expected to increase in the coming years. After producing the desired results, AI's medical tools will design highly accurate facial scans and interpret personalized treatment plans based on individual patients' data, including socially sensitive information that humans are less reliable in handling. This theoretical framework will enable predictive and preventive population health analysis, targeting populations with tailored strategies to improve health outcomes, reducing health disparities, and cutting costs. AI will certainly have strengths in assessing big data, summarizing important results in real-time for healthcare, and identifying financial opportunities that can be exploited. The implementation of AI into patient care models and population health strategies is a determinant step for achieving the universally recognized goals of enhancing patient outcomes, improving population health, curbing unnecessary healthcare spending, and delivering personalized services based on the preferences and characteristics of a given population.

9.3.1. Predictive Analytics and Disease Surveillance

Predictive analytics using AI has shown the potential to forecast disease outbreaks at the local, regional, national, and global scales. Specifically, they indicate "where" the spread of outbreaks will rise and offer early warning signs of abnormal health events. Surveillance by predictive models systematically monitors at-risk individuals based on behavioral patterns and predicts the number of new cases. AI-empowered surveillance-driven population health is a step towards integrated patient and population interests. This investigative progress will be instrumental in executing care management monitoring at the level of prevention and public health. A real-time location-based digital behavioral health tool for psychiatric care success management collects population health diagnostic patterned data for location-adjusted prediction and outcome monitoring after an emergency department visit. The entire care system currently prioritizes the location-based data collected pattern, analyzing granulated health indicators, to scan hotspots and allocate resources with granular precision. Analysis of data can deliver a unique feature—prioritization of the vulnerable in the same vulnerable area (Tulasi et al., 2022). Electronic syndromic surveillance enables reports to be analyzed to forecast treatment response at individual levels with artificial intelligence in pneumonia scenarios.

Potential intervention based on prediction is a powerful aid to ensure positive health outcomes. The concept of global surveillance is severely undermined in terms of data generation by the orthodoxy that prioritizes the use of hypothesis field testing for curative applications rather than real-time data and early prevention. Though randomization and other methods have produced progress on cancer-infection interactions, there is an urgent need for a new solution. Ethical considerations do occur with AI surveillance and unique data use, exemplified by recent controversies. Surveillance intended for improved treatment and management can frequently be ethically acceptable, even if there is a "threat" or discrimination involved, provided that scientific due diligence achieves reasonable reliability. As the modeling community perfects this technique, integrated population management, using predictive analytics for individual and community health, is indeed possible. The world policymaking environment has presented potentially striking issues. Expanding models of predictive surveillance and guidance from exclusive real-time data to inclusive recovery data will initiate significant progress towards incisive national healthcare agendas.

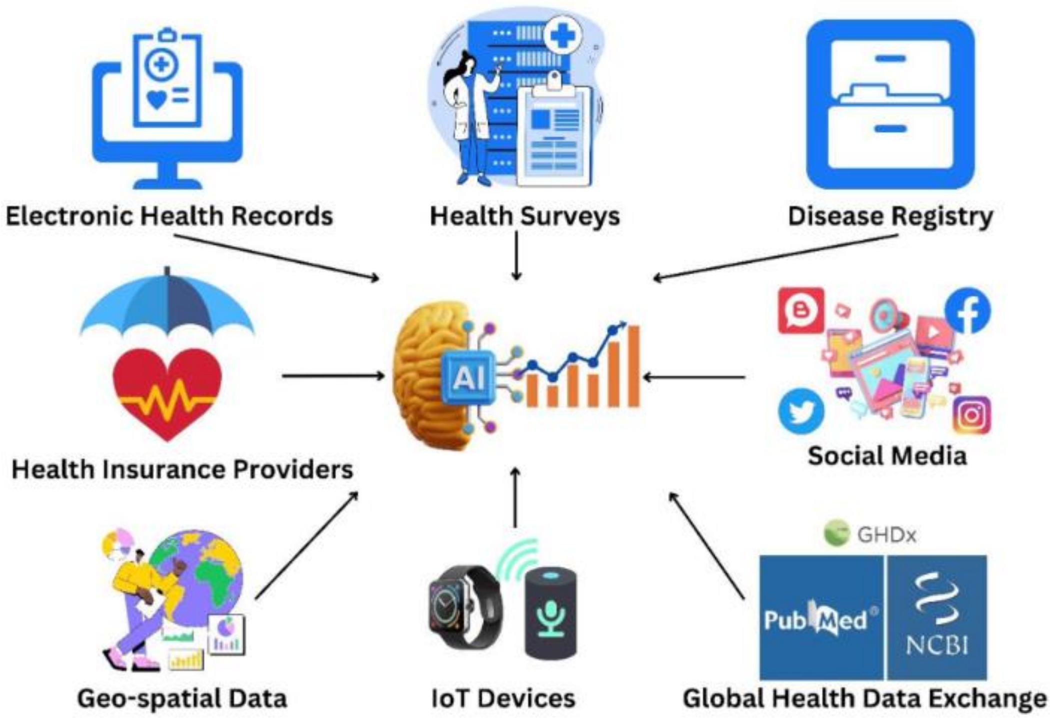

Fig 9 . 2 : Predictive Analytics and Disease Surveillance.

9.3.2. Personalized Medicine and Treatment

AI's potential to revolutionize the healthcare industry is the prospect of personalized medicine and treatment. Personalized medicine refers to the tailoring of treatment to the individual characteristics of patients. For example, numerous factors, from a person's genetics to environmental and lifestyle traits, can be combined by AI-based models to predict whether they are particularly at risk of developing or having a poor outcome if they are affected by preventable conditions. Machine learning models can be used to predict a person's expected response in terms of reduced risk of illness or vitality to different medicines or help to understand the likely adverse effects experienced by people who respond poorly (Venkata et al., 2022). Overall, the practice of personalized medicine is currently being enabled by AI technologies, allowing drugs to be targeted to smaller patient populations, thereby increasing their effectiveness and reducing the number of patients exposed to adverse effects from a drug that does not have any therapeutic benefit for them. Personalized medicine could, however, raise ethical questions, particularly in relation to the management of consent, data privacy issues, and patient acceptability. For example, if a patient is presented with a choice of treatments, some of which are predicted as 'better' options than others based on big data sources by AI, what responsibilities do healthcare providers have to ensure the patient understands the reasons in a transparent way? Although machine learning models are trained on an aggregated level, the results are processed and have to be interpreted according to an individual patient's treatment plan. Thus, personalized medicine ought to involve shared decision-making, with the patient at the center of the decision-making process, which shares healthcare data and research findings in a communicable manner. A further potentially advantageous development of utilizing AI for personalized treatment is a greater emphasis on patient engagement and tailoring information in ways that elicit an active interest and understanding in clinical solutions in individuals.

9.4. Impact of AI on Public Health Strategies

A tremendous advantage of using AI in health data analysis is the ability to develop highly accurate insights, pieces of information that are critical to all aspects of public health. One of the most common uses of AI in population health management is to assess both short- and long-term health trends. Identifying underlying diseases, examining potential treatment strategies, and evaluating the effectiveness of these programs is vital in managing a community's health. Similarly, AI can help public health professionals understand how quickly diseases spread across a population and how many outbreaks they have produced in the past. AI in population health abstracts helps develop new health policies and strategies for minimizing the impact of future epidemics. The ability to use AI to make predictions about future developments of this sort makes it invaluable when preparing for and responding to pandemics and seasonal health threats of any kind (Pandugula et al., 2024). AI also allows public health to take 'snapshots' of community acuity.

AI does more than manage the health of communities. It also plays a key role in how public health professionals inform a community about time-critical preventative care, new and safe treatments, and general wellness strategies. AI can optimize workplaces by adjusting workflows, reassigning personnel, and managing the intake of new patients based on the volume of care. Future health also can engage a community of patients and their network of family members, making sure that communities of interest receive properly tailored messages to support lifestyle and dietary changes. No aspect of a healthcare relationship is immune to the impact of AI. However, the implementation and convergence of systems and tools that will allow AI to actually change public health is not without its challenges. There are many considerations that go into using AI holistically in the public health sector. Unsurprisingly, ethical use is one such consideration. Since one of the main missions of public health is to ensure health equity and access, public health practitioners have an obligation to consider how introducing AI into the field will impact communities.

9.4.1. Preventive Interventions and Health Promotion

A major reason for public health's increasing interest in AI is the technology's ability to improve strategies for health promotion by enhancing preventive interventions. AI's use of predictive analytics to forecast population health can enable health departments to timely implement preventive measures and protect population health. In addition, AI also has a strong association with health promotional endeavors, enhancing their outreach, access, and effectiveness. AI technologies have the means to predict if certain groups of individuals are at higher risk of experiencing a certain condition, disease, or infection. After identifying these at-risk populations, public health entities can design specific preventive interventions targeting these groups to protect the entire population.

An example in this field includes public health entities pinpointing regions of new measles outbreaks for early vaccination. AI has the ability to revolutionize public awareness campaigns and procedures due to its advanced insights. Public health can utilize AI to gauge the population's reactions to current interventions and educate the community through optimal messaging. In addition, predictive analytics could also streamline the procedures to identify the regions and communities where such educational public health campaigns would have the most outreach and influence. AI's insights into where to target public health initiatives regarding health promotion and preventive campaigns are based on predicting the behaviors of both the individuals who are already healthy as well as the individuals with varying levels of susceptibility and symptom intensity for the condition of interest. AI can inform public health entities where to allocate resources to achieve the best results in educating their target audiences.

In some cases, AI can also help public health entities tailor the message for individuals. AI can predict individual patient outcomes and suggest messaging content for public health messaging. One of the goals of public health is to empower communities and individuals to influence their health. The area of behavior change can be challenging for AI to fully master. While a personal recommendation has the potential to activate a patient into preventive actions, behavior change is much more complex than a mere recommendation. This reaction also assumes the patient is aware of their health data and the future condition or complication. Additionally, there may be ethical or moral concerns about using data-based techniques, even predictive analytics, to influence people to make a specific decision. In general, beautiful and fully functional AI models are useless if people mistrust they were trained on the wrong data, which does not represent their cultural point of view or lived experiences. It is important to work closely with community stakeholders to ensure that AI modeling of the population's health is done appropriately and to understand public acceptability of AI interventions in public health (Kalisetty et al., 2023).

9.4.2. Health Policy and Decision Making

An important use case of AI is to generate insights that inform health policies that are more likely to be fit for purpose in improving population health. Policies based on an AI analysis of health service utilization tailored to local communities are more likely to address the health needs and weaknesses of those communities than general evidence and advice based on standard relationships between interventions and health outcomes. In England, the paradigm developed around the payment and performance policies of the NHS. The data could be used to evaluate the impact of health policy. For example, the NHS could fund AI analysis of outcomes for patients aged 75–85 years of two approved drugs for macular degeneration. These drugs could serve as a useful model to illustrate topics such as the ethics of intervention and the nature of treatment intention. The existing data in the UK National Institute for Health and Care Excellence registry would also provide more systematic and higher-quality information to inform AI algorithms.

An additional strength of employing AI models for health system and health service research is that it can be used to systematically evaluate the economic impact of policies and the nature of health gain or avoidable harm. Adequate targeting of public health strategies often involves ensuring that interest in and access to the topic are not confused. For example, we should ensure that educational resources are not targeted at people who are already at a reduced risk, based on factors such as socioeconomic status, geography, age, gender, maternal education, or mobility status. Similar strategies are likely to be cost-effective in health promotion. AI is increasingly used in all areas of health policy development and delivery. It also funded a study that recommended applying AI to incident response in health care and public health emergencies. The UK and the World Health Organization have published ethical guidelines for the use of AI in public health.

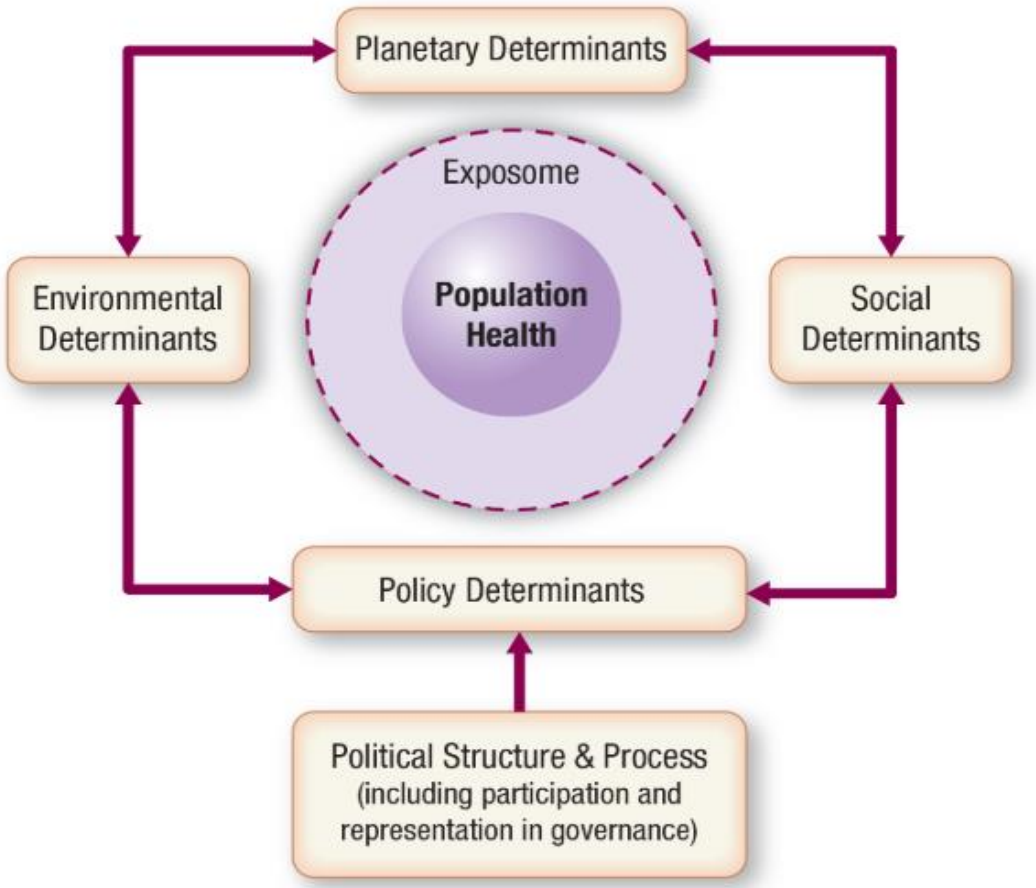

Fig 9 . 3 : Health Policy and Decision Making of Population Health Management.

9.5. Challenges and Ethical Considerations

The thought of a grand future with AI being part of managing public health is exciting. AI, however, is a suite of technologies, not a magic tool. Innate limits are posed by the technology itself, by the milieu in which AI functions, and by the level of data quality. Furthermore, we face technological challenges, such as incomplete automation in AI tools, regulatory barriers, disagreement between long and short data, and so on. Its potential will be fulfilled only if we know how to use it in the service of beneficiaries (Sondinti et al., 2023).

While there are clear opportunities to assist public health, we have to be aware of the potential challenges that could arise from the use of AI. At the technological side, apart from inherent limitations to directly use AI tools for disease control strategies, practical obstacles include the speed of responses, the necessary inclusivity of feedback, the diversity of settings, and the required local relevance. At the societal level, challenges are related to data security and privacy, trust in the process, and trust in the AI solution. Several gaps need to be filled before we are able to use AI for public health. Data security and privacy are major stakeholders' concerns and the main drivers of regulatory agendas. Particular attention and well-embedded policies are needed to protect health data. In addition, AI used in health interventions could systematically produce treatment gaps if not well applied for everyone. One of the ethical concerns we could be facing is that someone should not own better quality AI than another and that everyone must have equal access to AI based on good quality health data. This should be the basis of an ethical guideline. Are we really ready to use AI in the development of public health strategies and actions? Stakeholders will have to invest a lot to answer this and to bypass current adverse points. It is likely that stakeholder partnership is the basis of the answer in order to weigh the pros and cons. The application of a business case would help enormously in this regard, underpinning our resolute efforts in the search for evidence-based policy.

9.5.1. Data Privacy and Security

AI's potential to leverage data from across the health system to improve care holds tremendous promise. However, it is one thing to release data to the public once it has been de-identified to a high degree of probability, and quite another to freely share patient records with thousands of developers. Healthcare data is perhaps the most sensitive and individualized dimension of any person's private and personal information. Our collective trust in the medical infrastructure and professionals is a public health issue and becomes a risk to the integrity of healthcare if data leaks and breaches continue to mount.

Equation 2 : Resource Allocation Optimization

$$C_{\text{opt}} = \arg\min_{R} \left(\sum_{i=1}^{N} C_i(R_i) + \lambda \cdot G(R) \right)$$

C_{opt}: Optimal resource distribution strategy.

$C_i(R_i)$: Cost function for resources R_i allocated to individual i.

$G(R)$: Inequality measure for resource allocation R.

λ: Trade-off parameter between cost and equity.

Preventive strategies for the negative outcomes relative to privacy and security began with establishing frameworks for data categorization. These policies offer extensive legal definitions and protections for Personal Health Information. In practice, however, protected versus non-protected data has grown more ambiguous, especially with respect to De-Identified Protected Health Information, where sufficiently anonymized data are not subject to traditional protections. Recent federal legislation envisions a different approach, characterizing a wider array of data as necessary to healthcare and therefore subject to sharing. Modern, data-driven population health strategies depend heavily upon leveraging information that was not originally collected or intended for health and healthcare use and are therefore largely not covered by traditional protections. This cannot come at the expense of data privacy and security. Citizen and patient trust in our use of their data is hard-won and crucial to the integrity of the health systems and people. Unauthorized access to PHI remains a significant concern in the context of AI. Cybersecurity remains a paramount issue in the same AI-driven healthcare systems that would rely on robust connectivity and automated functions to produce results.

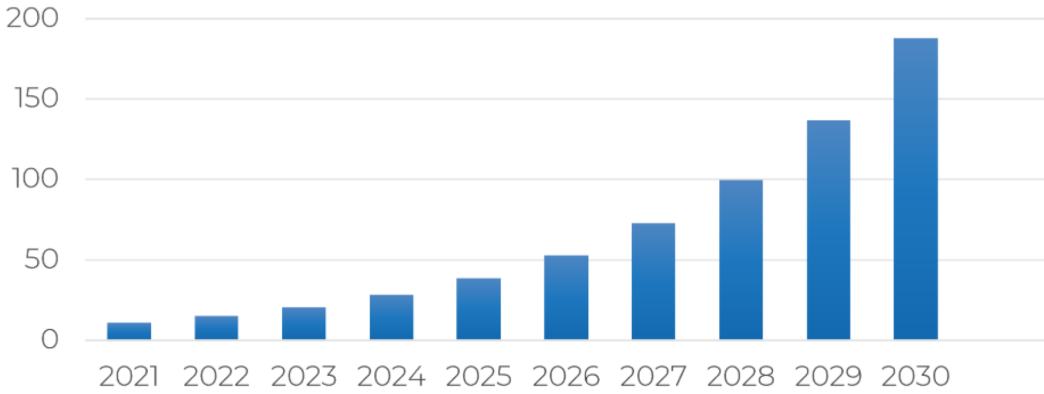

Fig 9 . 4 : Role of AI in Population Health Management.

Encryption is a promising method to protect health data, and dynamic encryption of data at rest and across the wire can present keys to only the patient, provider, and authorized experts. Combining homomorphic encryption, zero-knowledge proofs, and personal agents can support the secure exchange of fully encrypted personal health data between multiple parties. Blockchain is another emerging technology that could serve a role as a dissemination control point with trusted, distributed ledger record-keeping functionality across a health ecosystem. Innovative pathways to retrofitting the Internet and data-services framework are essential, as emerging technological ecosystems are often unstandardized. Finally, while all infrastructure and tools need to be developed with consideration to providing a maximum of individual privacy – meaning that they should clearly prioritize the privacy for the individual should there be a scale of optimization that requires a trade-off – everyone within this ecosystem, including the technical developers, software providers, consultancy groups focused on data protection, healthcare providers and clinicians, social workers, policymakers, public health professionals, and those leading health and healthcare corporate structures must have a baseline expertise and fluency in data protection at the level of individual service delivery and system realities. Data in transit, for example, in records sharing, can nevertheless elevate the risk that the data will be vulnerable to outside individuals and tampering. Based on this assumption, the transit mechanism, the consent mechanism, and the sharing protocol each have roles and responsibilities to protect the individual participant.

9.5.2. Bias and Fairness in AI Algorithms

Biased data can lead these algorithms to make decisions that look quite different for different patient populations. In some cases, the data contain unfair patterns that concern gender or racial/ethnic subgroups, which can exacerbate health disparities by providing better treatment for some but not others. To prevent this from happening and to satisfy laws, it is important to design population health and public health strategies in ways that intentionally consider what algorithms are doing to achieve fairness. Additional layers of complexity arise when people attempt to remove the bias from AI systems by modifying their training data or by training the algorithms in ways designed to reduce the disparities in the results if given different population statistics as input data. Once researchers have determined which features in the data are most closely associated with how the algorithm will treat different subgroups and designed the input data schemes in ways that mitigate this, they must still evaluate their systems on data that models an independent data collection in order to verify that they have been successful in building a fairness-aware algorithm.

The complexity and privacy challenges inherent in trying to define and create an unbiased data set for use in automating the delivery of patient care have led to diverse opinions on this issue. One group of experts advises that special attention be given to expert judgment in discretizing the features in electronic health records so that no race-based associations are perpetuated in the data. Another solution is to ensure that public health practitioners have direct access to the people involved in the care process in order to improve community trust and relationships. Recommendations also suggest rules be put in place to ensure the transparency of these algorithms so that those who are judged by them can evaluate when and why they receive a given decision; this is especially important in giving entities the knowledge to appeal when an automated decision was unfair or otherwise problematic. Although some researchers have suggested a simpler strategy could be implemented by ensuring all the relevant boundary judgments are made by humans supervised with clear guidelines but ultimately overseen by AI, most legal scholars have argued this is implausible due to the aforementioned reasons. All the while in the legal space, a leading data protection agency sharply criticized another algorithm as capable of perpetuating racial bias. This trend is indicative of a 'colonial imagination' brought to these algorithms, where human biases are ultimately distilled and thereby kept out of sight.

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