



Review Article

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The Human Factor: Integrating AI with Public Health Expertise

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Abstract

The integration of artificial intelligence (AI) into public health holds immense promise for improving population health outcomes. However, the successful implementation of AI depends not solely on technological advancements, but crucially on the effective integration of human expertise. This paper explores the “human factor” in AI-driven public health, emphasizing the synergistic relationship between AI tools and the specialized knowledge of public health professionals. We examine the roles of human judgment in data interpretation, ethical decision-making, and the contextual application of AI-generated insights. Furthermore, we discuss the importance of training and education to equip public health practitioners with the skills necessary to leverage AI effectively. By fostering a collaborative environment where AI complements rather than replaces human expertise, we can ensure that AI serves as a powerful tool for enhancing public health practice and promoting equitable health outcomes.

Keywords: Artificial Intelligence (AI); Public Health; Human Expertise; Data Interpretation; Ethical Decision-Making; Training, Education; Collaboration; Health Equity; Implementation Science; AI Integration.

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Introduction

The dawn of artificial intelligence (AI) has ushered in an era of unprecedented potential across numerous sectors, and public health is no exception. From predictive modeling of disease outbreaks to personalized interventions for chronic conditions, AI [1-12] promises to revolutionize how we understand, manage, and improve population health. However, the allure of technological solutions must be tempered with a critical understanding of the complex interplay between AI and the human element. While algorithms can process vast datasets and identify patterns invisible to the human eye, they lack the nuanced judgment, contextual understanding, and ethical considerations that are intrinsic to effective public health practice. This paper delves into the crucial “human factor” in AI-driven public health, arguing that the true transformative power of AI lies not in replacing human expertise, but in augmenting it through a synergistic partnership.

The traditional landscape of public health relies heavily on the expertise of epidemiologists, biostatisticians, public health nurses, community health workers, and policymakers. These professionals bring a wealth of knowledge, experience, and critical thinking to the table, interpreting data, designing interventions, and navigating the social determinants of health. AI, with its capacity for rapid data analysis and pattern recognition, offers a powerful tool to enhance these existing capabilities. For example, AI algorithms can analyze vast datasets of electronic health records, social media data, and environmental monitoring data to identify emerging disease trends, predict high-risk populations, and personalize public health interventions. However, the interpretation of these AI-generated insights requires the expertise of public health professionals who can contextualize the findings, consider ethical implications, and translate them into actionable strategies.

One of the key challenges in integrating AI into public health is the potential for algorithmic bias. AI models are trained on historical data, which may reflect existing societal biases and inequalities. If these biases are not addressed, AI-driven interventions may perpetuate or even exacerbate health disparities. Human expertise is essential in identifying and mitigating these biases, ensuring that AI serves to promote health equity rather than reinforce existing inequities. Public health professionals can bring their understanding of social determinants of health and their commitment to social justice to the design and implementation of AI-driven interventions.

Furthermore, the implementation of AI [13-20] in public health requires a deep understanding of the local context. Public health interventions are not one-size-fits-all. They must be tailored to the specific needs and characteristics of the communities they serve. This requires a nuanced understanding of cultural factors, social norms, and community resources. While AI can provide valuable insights into population-level trends, it cannot replace the local knowledge and community engagement that are essential for effective public health practice. Public health professionals, with their established relationships with communities and their understanding of local contexts, are crucial for ensuring that AI-driven interventions are culturally appropriate and responsive to community needs.

Beyond the technical aspects of AI implementation, the ethical considerations are paramount. Data privacy, informed consent, and algorithmic transparency are critical issues that must be addressed to maintain public trust in AI-driven public health. Public health professionals, with their commitment to ethical principles and their understanding of the sensitive nature of health data, are essential for ensuring that AI is used responsibly and ethically. They can play a vital role in developing ethical frameworks for AI in public health, advocating for data privacy protections, and ensuring that AI is used in a way that respects the rights and dignity of individuals and communities.

The successful integration of AI into public health also requires a commitment to training and education. Public health professionals need to be equipped with the skills and knowledge necessary to understand and leverage AI tools effectively. This includes training in data literacy, AI concepts, and ethical considerations. Educational programs should focus on developing critical thinking skills, problem-solving abilities, and the ability to work collaboratively with AI specialists. By investing in training and education, we can ensure that public health professionals are prepared to lead the way in the age of AI.

Challenges

While the potential benefits of integrating AI [21-23] into public health are substantial, several significant challenges must be

addressed to ensure successful and ethical implementation. These challenges span technical, ethical, and practical domains, requiring careful consideration and proactive solutions.

1. Data Quality and Availability

- **Data Fragmentation:** Public health data is often fragmented across various systems, including electronic health records, surveillance databases, and social media platforms. Integrating these disparate data sources is a complex undertaking, requiring standardized data formats and interoperability.
- **Data Bias:** AI models are trained on historical data, which may reflect existing societal biases related to race, ethnicity, socioeconomic status, and other factors. These biases can lead to discriminatory outcomes if not carefully addressed.
- **Data Gaps:** Certain populations or geographic areas may have limited data available, leading to incomplete or inaccurate AI [24-26] models. This can exacerbate existing health disparities.
- **Data Security and Privacy:** Public health data is highly sensitive, requiring robust security measures to protect patient privacy and prevent unauthorized access. Balancing data sharing for research and public health purposes with individual privacy rights is a critical challenge.

2. Ethical and Legal Considerations

- **Algorithmic Bias and Fairness:** Ensuring that AI algorithms are fair and unbiased is essential for promoting health equity. Developing methods for detecting and mitigating bias in AI models is a critical research priority.
- **Informed Consent and Transparency:** Patients and communities need to understand how their data is being used in AI-driven public health initiatives. Ensuring transparency and obtaining informed consent are crucial for building public trust.
- **Accountability and Responsibility:** Determining who is responsible for the outcomes of AI-driven decisions is a complex issue. Establishing clear lines of accountability is essential for ensuring that AI is used responsibly.
- **Data Ownership and Access:** Clarifying data ownership and access rights is crucial for ensuring equitable access to the benefits of AI in public health.

3. Human-AI Interaction and Integration

- **Trust and Acceptance:** Public health professionals and the public may be hesitant to trust AI-driven recommendations. Building trust requires demonstrating the reliability and validity of AI models, as well as providing clear explanations of how they work.
- **Training and Education:** Public health professionals

need to be trained in data literacy, AI concepts, and ethical considerations. Integrating AI training into public health curricula and providing ongoing professional development opportunities are essential.

- **Workflow Integration:** Integrating AI tools into existing public health workflows can be challenging. Ensuring seamless integration requires careful planning and collaboration between AI specialists and public health practitioners.
- **Maintaining Human Oversight:** Preventing over-reliance on AI, and ensuring that human experts are still involved in the decision making process is essential.

4. Implementation and Resource Constraints

- **Infrastructure and Technology:** Implementing AI in public health requires significant investments in infrastructure, technology, and data management systems. Resource constraints can limit the adoption of AI in resource-limited settings.
- **Scalability and Sustainability:** Developing AI solutions that can be scaled and sustained over time is a critical challenge. Ensuring that AI initiatives are integrated into long-term public health strategies is essential.
- **Interoperability:** Ensuring that different AI [27-29] systems and data platforms can communicate with each other is crucial for enabling data sharing and collaboration.
- **Community Engagement:** Successful AI implementation requires active engagement with communities. Ensuring that community needs and perspectives are considered in the design and implementation of AI initiatives is essential.

Benefits of Integrating AI with Public Health Expertise

The strategic integration of artificial intelligence (AI) with human expertise in public health offers a multitude of benefits, driving significant improvements in population health outcomes, efficiency, and equity. Here are some key advantages:

1. Enhanced Disease Surveillance and Outbreak Prediction

- **Early Detection:** AI algorithms can analyze vast datasets from diverse sources (e.g., social media, search engine trends, electronic health records) to detect early signs of disease outbreaks, enabling rapid response and containment.
- **Predictive Modeling:** Machine learning models can predict the spread of infectious diseases, allowing public health officials to allocate resources effectively and implement targeted interventions.
- **Real-time Monitoring:** AI-powered surveillance systems can provide real-time monitoring of disease trends, enabling timely adjustments to public health strategies.

2. Improved Efficiency and Resource Allocation

- **Automation of Routine Tasks:** AI can automate routine tasks, such as data entry, analysis, and report generation, freeing up public health professionals to focus on more complex and strategic activities.
- **Optimized Resource Allocation:** AI [30-33] can analyze data to identify areas of greatest need, allowing for more efficient allocation of resources, such as personnel, funding, and medical supplies.
- **Reduced Costs:** AI-driven interventions can reduce healthcare costs by preventing disease, improving treatment outcomes, and streamlining administrative processes.

3. Personalized Public Health Interventions

- **Tailored Interventions:** AI can analyze individual-level data to identify risk factors and tailor interventions to specific needs, improving adherence and effectiveness.
- **Precision Medicine:** AI can contribute to precision medicine approaches by identifying subgroups of individuals who are most likely to benefit from specific treatments or interventions.
- **Behavioral Change:** AI-powered tools can provide personalized feedback and support to individuals seeking to adopt healthier behaviors.

4. Enhanced Health Equity

- **Identification of Disparities:** AI can analyze data to identify disparities in health outcomes across different populations, enabling targeted interventions to address inequities.
- **Improved Access to Care:** AI-powered telehealth and remote monitoring tools can improve access to care for underserved populations, particularly in rural or remote areas.
- **Culturally Competent Interventions:** AI can be used to develop culturally competent interventions that are tailored to the specific needs and preferences of diverse communities.

5. Accelerated Research and Innovation

- **Data-Driven Discovery:** AI can accelerate the pace of public health research by analyzing vast datasets to identify new patterns and insights.
- **Drug Discovery and Development:** AI can be used to accelerate the development of new drugs and vaccines, particularly in response to emerging infectious diseases.
- **Improved Clinical Decision Support:** AI-powered clinical decision support systems can provide clinicians with real-time access to evidence-based guidelines and best practices.

6. Strengthened Public Health Communication

- **Combatting Misinformation:** AI can be used to identify and combat the spread of misinformation related to public health issues.
- **Targeted Messaging:** AI can be used to develop targeted public health messages that are tailored to the specific needs and preferences of different populations.
- **Improved Health Literacy:** AI-powered tools can be used to improve health literacy by providing individuals with access to reliable and understandable health information.

Future Works: Advancing the Integration of AI with Public Health Expertise

The integration of AI into public health is a rapidly evolving field, and numerous avenues for future research and development exist. Here are some key areas for future work aimed at maximizing the benefits of this synergy:

1. Enhancing Ethical Frameworks and Governance

- **Developing robust ethical guidelines:** Research should focus on establishing comprehensive ethical frameworks for AI in public health, addressing issues such as algorithmic bias, data privacy, and informed consent.
- **Creating transparent and accountable systems:** Future work should prioritize the development of AI systems that are transparent, explainable, and accountable, enabling public trust and responsible innovation.
- **Establishing regulatory frameworks:** Research should inform the development of regulatory frameworks that govern the use of AI [34-36] in public health, ensuring safety, efficacy, and equity.

2. Advancing AI-Driven Public Health Tools and Applications

- **Improving predictive modeling:** Future research should focus on developing more accurate and robust AI models for predicting disease outbreaks, chronic disease risk, and other public health outcomes.
- **Developing personalized interventions:** Research should explore the development of AI-powered personalized interventions that are tailored to individual needs and preferences.
- **Enhancing real-time surveillance:** Future work should focus on developing AI-driven real-time surveillance systems that can rapidly detect and respond to emerging public health threats.
- **AI for environmental health monitoring:** Expand the uses of AI to monitor environmental impacts on health, such as air and water quality.

3. Strengthening Human-AI Collaboration

- **Developing user-friendly AI interfaces:** Future work should prioritize the development of user-friendly AI interfaces that are accessible to public health professionals with varying levels of technical expertise.
- **Integrating AI into public health workflows:** Research should focus on developing strategies for seamlessly integrating AI tools into existing public health workflows.
- **Developing training and education programs:** Future work should focus on developing comprehensive training and education programs for public health professionals, equipping them with the skills and knowledge necessary to leverage AI effectively.
- **Studying Human-AI interaction:** more research is needed to understand how human experts and AI systems can collaborate most effectively.

4. Addressing Data Challenges and Promoting Data Equity

- **Developing methods for mitigating data bias:** Future research should focus on developing methods for detecting and mitigating bias in AI models, ensuring fairness and equity.
- **Improving data interoperability:** Research should focus on developing standards and technologies for improving data interoperability across different public health systems.
- **Addressing data gaps:** Future work should focus on developing strategies for addressing data gaps and improving data availability in underserved [37] populations.
- **Improving data security and privacy:** Research should prioritize the development of robust data security and privacy measures to protect sensitive public health data.

5. Fostering Community Engagement and Participation

- **Developing participatory AI approaches:** Future work should explore the development of participatory AI approaches that involve communities in the design and implementation of AI-driven public health initiatives.
- **Building public trust:** Research should focus on developing strategies for building public trust in AI-driven public health initiatives.
- **Addressing health literacy:** Future research should address the importance of health literacy in the context of AI implementation.

6. Interdisciplinary Collaboration

- Promoting collaboration between AI specialists and

public health professionals: Future work should emphasize the importance of interdisciplinary collaboration between AI [38,39] specialists, public health professionals, ethicists, policymakers, and community members.

- Establishing research networks: Establishing research networks focused on AI in public health can facilitate collaboration and knowledge sharing.
- Funding interdisciplinary research: Increased funding for interdisciplinary research projects is essential for advancing the field.

Conclusion

The integration of artificial intelligence (AI) with human expertise represents a paradigm shift in public health, offering unprecedented opportunities to improve population health outcomes, enhance efficiency, and promote health equity. While AI's ability to analyze vast datasets, predict disease outbreaks, and personalize interventions is undeniably powerful, its true potential lies in its synergistic relationship with the knowledge, judgment, and ethical considerations that human experts bring to the table.

This paper has explored the crucial "human factor" in AI-driven public health, highlighting the importance of human expertise in data interpretation, ethical decision-making, and the contextual application of AI-generated insights. We have also addressed the significant challenges that must be overcome, including data quality and availability, ethical and legal considerations, human-AI interaction, and implementation constraints.

However, the benefits of successful integration are immense. AI can empower public health professionals to make more informed decisions, allocate resources more effectively, and deliver more targeted interventions. By automating routine tasks and providing real-time insights, AI can free up human experts to focus on the complex and nuanced aspects of public health practice.

References

1. Panahi O, Raouf MF, Patrik K. (2011) The Evaluation Between Pregnancy and Periodontal Therapy. *Int J Acad Res.* 3: 1057-1058.
2. Panahi O, Melody FR, Kennet P, Tamson MK. (2011) Drug Induced (Calcium Channel Blockers) Gingival Hyperplasia. *JMBS.* 2: 10-12.
3. Omid P. (2011) Relevance Between Gingival Hyperplasia and Leukemia. *Int J Acad Res.* 3: 493-494.
4. Panahi O, Ketenci Çay F. (2023) Nanotechnology, Regenerative Medicine and Tissue Bio-Engineering. *Acta Scientific Dental Sciences.* 7: 118-122.
5. Panahi O. (2024) Dental Pulp Stem Cells: A Review. *Acta Scientific Dental Sciences.* 8: 22-24.
6. Panahi O, Jabbarzadeh M. (2025) The Expanding Role of Artificial Intelligence in Modern Dentistry. *On J Dent & Oral Health.* 8: 2025.
7. Omid P, Shabnam D. (2025) Mitigating Aflatoxin Contamination in Grains: The Importance of Postharvest Management Practices. *Adv Biotech & Micro.* 18: 555996.
8. Panahi O, Farrokh S. (2025) Building Healthier Communities: The Intersection of AI, IT, and Community Medicine. *Int J Nurs Health Care.* 1: 1-4.
9. Panahi O, Ezzati A. (2025) AI in Dental-Medicine: Current Applications & Future Directions. *Open Access J Clin Images.* 2: 1-5.
10. Koyuncu B, Gokce A, Panahi P. (2015) Reconstruction of an Archeological Site in Real-Time Domain by Using Software Techniques. *IEEE.* 1350-1354.
11. Panahi O, Farrokh S. (2025) The Use of Machine Learning for Personalized Dental-Medicine Treatment. *Glob J Med Biomed Case Rep.* 1: 001.
12. Panahi U. (2025) AD HOC Networks: Applications, Challenges, Future Directions. *Scholars' Press.*
13. Panahi O. (2025) Artificial Intelligence in Dentistry. *Scholars Press Academic Publishing.*
14. Panahi P, Freund M. (2011) Safety Application Schema for Vehicular Virtual Ad Hoc Grid Networks. *Int J Acad Res.* 3: 2.
15. Panahi P. (2009) New Plan for Hardware Resource Utilization in Multimedia Applications Over Multi-Processor Based System. *MIPRO International Convention Conference on GRID and Visualization Systems.* 256-260.
16. Koyuncu B, Panahi P. (2014) Kalman Filtering of Link Quality Indicator Values for Position Detection by Using WSNS. *Int J Computing, Communications & Instrumentation Engg.* 1.
17. Panahi O. (2025) The Algorithmic Healer: AI's Impact on Public Health Delivery. *Medi Clin Case Rep J.* 3: 759-762.
18. Panahi O. (2025) The Future of Healthcare: AI, Public Health, and the Digital Revolution. *Medi Clin Case Rep J.* 3: 763-766.
19. Panahi O. (2013) Comparison Between Unripe Makopa Fruit Extract on Bleeding and Clotting Time. *Int J Paediatr Dent.* 23: 205.
20. Panahi O, Arab MS, Tamson KM. (2011) Gingival Enlargement and Relevance With Leukemia. *Int J Acad Res.* 3.
21. Panahi O, Melody FR. (2011) A Novel Scheme About Extraction Orthodontic and Orthotherapy. *Int J Acad Res.* 3.
22. Panahi O, Nunag GM, Nourinezhad Siyahtan A. (2011) Molecular Pathology: Correlation of Helicobacter Pylori and Prevalent Infections in Oral Cavity. *Cell J (Yakhteh).* 12: 91-92.
23. Panahi P, Bayılmış C, Çavuşoğlu U, Kaçar S. (2018) Performance Evaluation of L-Block Algorithm for IoT Applications. *3rd International Conference on Computer Science and Engineering.* 609-612.
24. Panahi P, Bayılmış C, Çavuşoğlu U, Kaçar S. (2019) Comparing PRESENT and LBlock Block Ciphers Over IoT Platform. *12th International Conference on Information Security and Cryptology.* 66-69.
25. Panahi U. (2022) Secure Communication Model Based on Lightweight Cryptographic Algorithms for IoT. *Sakarya University.*
26. Koyuncu B, Panahi P, Varlioglu S. (2015) Comparative Indoor Localization by Using Landmarc and Cricket Systems. *Int J Emerg Tech Adv Eng.* 5: 453-456.

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27. Panahi O. (2025) Secure IoT for Healthcare. *Eur J Innov Stud Sustain*. 1: 1-5.
28. Omid P, Farrokh E. (2024) Beyond the Scalpel: AI, Alternative Medicine, and the Future of Personalized Dental Care. *J Complement Med Alt Healthcare*. 13: 555860.
29. Panahi O, Farrokh S. (2025) Ethical Considerations of AI in Implant Dentistry: A Clinical Perspective. *J Clin Rev Case Rep*. 10: 1-5.
30. Panahi O, Amirloo A. (2025) AI-Enabled IT Systems for Improved Dental Practice Management. *On J Dent & Oral Health*. 8: 2025.
31. Panahi O, Ezzati A, Zeynali M. (2025) Will AI Replace Your Dentist? The Future of Dental Practice. *On J Dent & Oral Health*. 8: 2025.
32. Omid P, Farrokh S. (2025) Bioengineering Innovations in Dental Implantology. *Curr Trends Biomed Eng Biosci*. 23: 556111.
33. Panahi O, Eslamlou SF. (2025) Artificial Intelligence in Oral Surgery: Enhancing Diagnostics, Treatment, and Patient Care. *J Clin Dent Oral Care*. 3: 1-5.
34. Panahi O, Dadkhah S. (2025) Transforming Dental Care: A Comprehensive Review of AI Technologies. *J Stoma Dent Res*. 3: 1-5.
35. Panahi P, Bayılmış C, Çavuşoğlu U, Kaçar S. (2021) Performance Evaluation of Lightweight Encryption Algorithms for IoT-Based Applications. *Arab J Sci Eng*. 46: 4015-4037.
36. Panahi U, Bayılmış C. (2023) Enabling Secure Data Transmission for Wireless Sensor Networks Based IoT Applications. *Ain Shams Eng J*. 14: 101866.
37. Panahi O, Panahi U. (2025) AI-Powered IoT: Transforming Diagnostics and Treatment Planning in Oral Implantology. *J Adv Artif Intell Mach Learn*. 1: 1-4.
38. Panahi O. (2025) The Algorithmic Healer: AI's Impact on Public Health Delivery. *Medi Clin Case Rep J*. 3: 759-762.
39. Panahi O. (2025) The Future of Healthcare: AI, Public Health, and the Digital Revolution. *Medi Clin Case Rep J*. 3: 763-766.