ICT in Breaking the Barriers of Repositioning the Practice and Development of Modern Public Health Technology.

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Abstract

This study explored and analyzes the significance of ICT in modern public health technology practice and development encompassing various aspects such as data collection and analysis, telemedicine and telehealth, health information systems, mobile health applications, public health surveillance and monitoring, e-learning and capacity building, data privacy and security, public health communication and information dissemination, collaboration and partnerships, and policy and regulatory frameworks. The study examined the various ICT tools, applications, and strategies used in the field of modern public health technology, and their impact on healthcare outcomes majorly through interviews and reviews. Its findings reveal the fact that ICT is a major instrument that will break the barriers to better reposition Public Health Technology practice to meet up with today's global requirement. With ICT properly integrated into this profession, its practice becomes easier, without barriers or limits of coverage, seamless and accurate. By understanding the role of ICT in repositioning public health technology, this research sheds light on the opportunities associated with its implementation, as well as provide insights into best practices and future directions.

Keywords: ICT, Healthcare, Public health technology.

Introduction

The role of technology in public health improvement is dynamic and continues to evolve with emerging innovations. By harnessing the power of technology, public health professionals can leverage data, enhance healthcare delivery, strengthen disease surveillance, and empower individuals to take charge of their health. The effective integration of technology into public health practice holds immense potential for transforming healthcare systems and improving population health outcomes. Public health technology refers to the application of technology, particularly information and communication technology (ICT), in the field of public health to improve healthcare practices, enhance data collection and analysis, and facilitate effective communication and collaboration among healthcare professionals. It encompasses a wide range of tools, systems, and strategies that contribute to the prevention, control, and management of diseases, promotion of health, and overall well-being of populations. The concept of public health technology revolves around harnessing the power of technology to address public health challenges. It involves leveraging digital tools and innovations to optimize healthcare delivery, surveillance, education, and policy-making. By utilizing technology, public health professionals can gather and analyze data more efficiently, monitor and respond to disease outbreaks in real-time, and disseminate crucial information to the public. This integration of technology into public health practices has the potential to transform healthcare systems and improve population health outcomes.

Evolution of Public Health Technology

The evolution of public health technology can be traced back to the early advancements in healthcare and the adoption of technology for medical purposes. Public health evolved through trial and error and with expanding scientific medical knowledge, at times controversial, often stimulated by war and natural disasters. The evolution of public health is a continuing process; pathogens change, as do the environment and the host. In order to face the challenges ahead, it is important to have an understanding of the past. From the invention of the microscope by Antonie van Leeuwenhoek in the 17th century to the development of vaccines and antibiotics, technological breakthroughs have played a pivotal role in improving public health. In recent decades, the rapid advancement of ICT has revolutionized the field of public health. The emergence of computers, the internet, and mobile devices has facilitated the collection, storage, and transmission of health-related data. Electronic health records (EHRs) have replaced paper-based systems, enabling healthcare providers to access and share patient information seamlessly. Moreover, the proliferation of smartphones and mobile applications has led to the rise of mobile health (mHealth) interventions, empowering individuals to monitor their health, receive health-related information, and engage in self-care practices.

Role of Technology in Public Health Improvement

The effective integration of the role of technology into public health practice holds immense potential for transforming healthcare systems and improving population health outcomes. Technology plays a crucial role in improving public health outcomes in several ways:

Enhanced Data Collection and Analysis: Technology enables the collection, storage, and analysis of vast amounts of health-related data. Through electronic data capture systems and wearable devices, public health professionals can gather real-time information on disease prevalence, risk factors, and health behaviors. Advanced data analytics tools help identify patterns, trends, and associations, facilitating evidence-based decision-making and targeted interventions.

Timely Disease Surveillance and Response: Technology enables the establishment of robust disease surveillance systems that monitor the occurrence and spread of diseases in real-time. Early warning systems can detect outbreaks and epidemics promptly, allowing public health authorities to initiate timely response measures such as contact tracing, vaccination campaigns, and public health advisories. Through integration of ICT into Public health has enhanced cluster detection and disease outbreaks detections of either known or unknown agents even before anyone realizes it thereby enhancing quicker response. Janet, et al, (2019)

Remote Healthcare Delivery: Telemedicine and telehealth technologies have transformed healthcare delivery by enabling remote consultations, diagnosis, and treatment. Through video conferencing and remote monitoring devices, individuals can access healthcare services from the comfort of their homes, reducing the need for physical visits and improving access to care, especially in rural or underserved areas. ICT according to Thierry, et al, (2016) is one of the major instruments for efficient remote healthcare delivery.

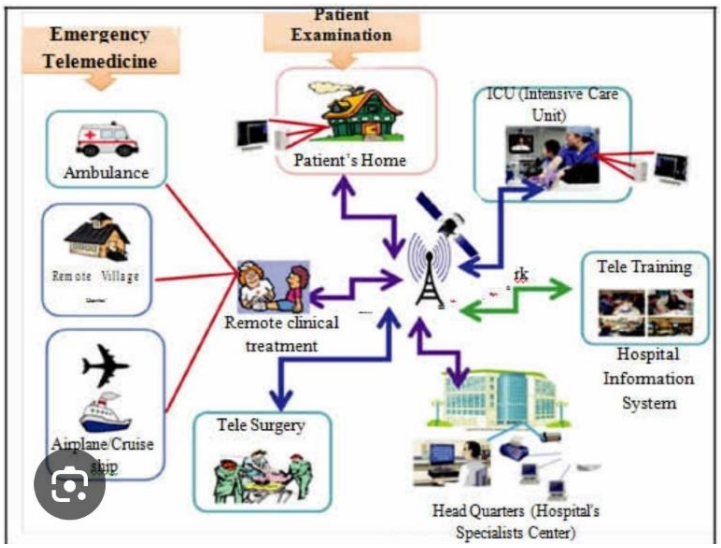


Fig 1: A typical Remote Healthcare Delivery System ***Source: [PubMed]***

Empowering Individuals for Self-care: Technology empowers individuals to actively participate in their own healthcare through self-monitoring and self-management tools. Mobile health applications and wearable devices enable individuals to track their physical activity, monitor vital signs, and receive personalized health recommendations. This promotes preventive care and empowers individuals to make informed decisions about their health.

Effective Health Communication: Technology plays a vital role in facilitating effective health communication and information dissemination. Digital platforms, social media, and mobile applications serve as channels for delivering health education, awareness campaigns, and public health advisories. This enables public health agencies to reach a broader audience, engage with the community, and promote health-promoting behaviors. Health literacy through better

communication brings about an empowerment for self-care amongst the population which will also in reducing pressure on the Primary Health care medical services. Amina, et al., (2013).

Collaboration and Partnerships: Technology fosters collaboration and partnerships among public health professionals, researchers, and policymakers. Virtual platforms, webinars, and online forums facilitate knowledge sharing, networking, and collaboration on research projects, policy development, and capacity-building initiatives. These digital tools enable cross-sectoral collaboration, leading to innovative solutions and improved public health outcomes.

Health Information Systems: Technology facilitates the implementation of robust health information systems that centralize and streamline health data management. Electronic Health Records (EHRs) enable healthcare providers to access comprehensive patient information, resulting in better coordination and continuity of care. Interoperable health information systems allow for seamless data exchange between different healthcare settings, improving care transitions and reducing medical errors.

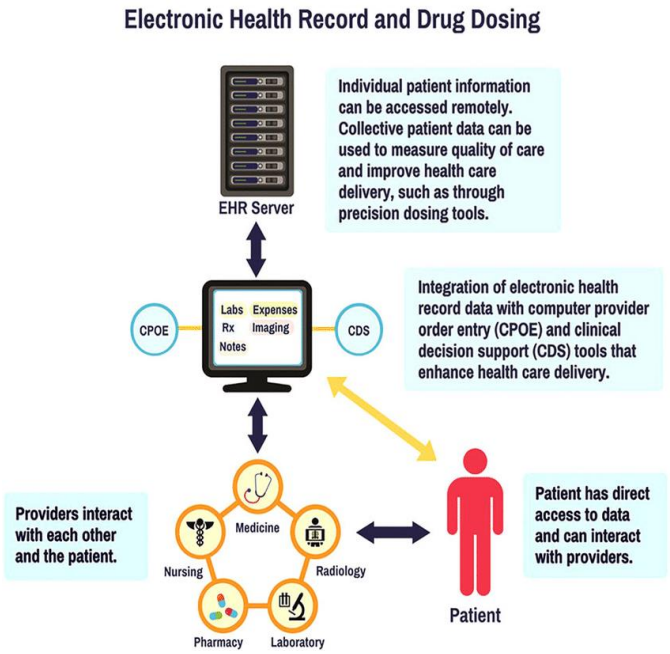


fig 2. A visual representation of a health information system, showcasing the integration of EHRs, data exchange, and interoperability between healthcare providers. ***Source: [PubMed]***

Understanding ICT in Public Health

Information and Communication Technology (ICT) refers to the diverse set of technological tools and systems that facilitate the collection, storage, processing, transmission, and dissemination of information. ICT encompasses a wide range of digital technologies, including computers, software applications, telecommunications networks, the internet, and mobile devices. In the context of public health, ICT plays a crucial role in transforming healthcare practices, improving data management and analysis, enhancing communication and collaboration, and empowering individuals to take charge of their health.

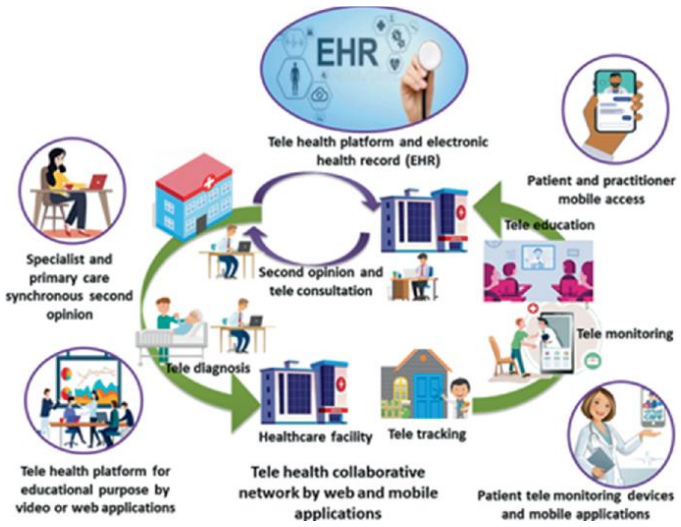


Fig 3. An infographic depicting the components of ICT, including computers, networks, mobile devices, and software applications, highlighting their relevance in public health.

ICT Applications in Public Health Technology

ICT finds extensive applications in various aspects of public health, revolutionizing healthcare practices and systems. Some key ICT applications in public health include:

Data Collection and Management: ICT tools facilitate efficient and accurate data collection in public health. Electronic data capture systems enable the digital collection of health-related information, replacing paper-based methods. Mobile applications, wearable devices, and remote monitoring technologies allow real-time data collection on vital signs, disease symptoms, and health behaviors. These data are then stored and managed in electronic databases, ensuring accessibility and efficient data analysis. Janet J etal (2019) said that in recent years, public health agencies have benefitted from technologic advances that support outbreak detection—whether the outbreak is caused by a known or unknown hence, ICT has provided a shift from the traditional way of data collection and Management in public health that required site visits necessary to identify crucial information to establish relationship for required investigation; but now with ICT, field data collection, analysis and Management can be performed off-site or by others not part of the on-site team. With the emergence of Internet of things (IoT), high volumes of high-speed real-time data in different formats from vast number of sources that can be analyzed quickly for timely response, according to Fabiana and Inna (2021)

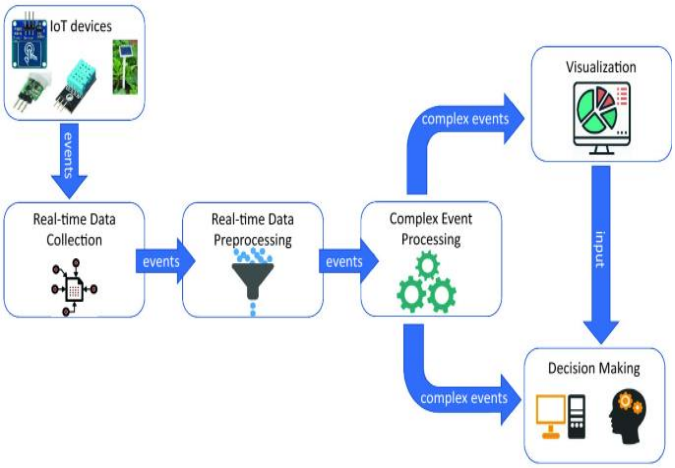


Fig 4. A visual representation of a mobile application used for data collection, showcasing how ICT enables real-time data capture and efficient management.

Disease Surveillance and Monitoring: ICT enables real-time disease surveillance and monitoring, crucial for detecting and responding to outbreaks. Surveillance systems collect data from various sources, including healthcare facilities, laboratories, and community reporting. Advanced analytics tools process these data to identify disease trends, geographical hotspots, and high-risk populations. Real-time monitoring and early warning systems alert public health authorities to potential threats, allowing for swift response and intervention.

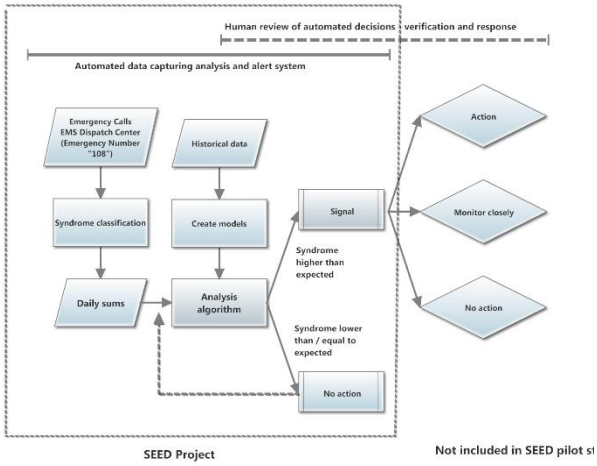


Fig 5. A diagram illustrating the flow of data in a disease surveillance system, showcasing the role of ICT in detecting disease outbreaks and enabling timely response.

Telemedicine and Telehealth: ICT facilitates remote healthcare delivery through telemedicine and telehealth. *Telemedicine is one of the most prominent, known and used branches of Telehealth, according to the American Telemedicine Association (ATA).* Telemedicine allows healthcare providers to diagnose and treat patients remotely using video conferencing and digital diagnostic tools. According to Michael Y.U et al, (2020) "Telemedicine is the best and primary mechanism for SARS-CoV-2 patients to continue to see their healthcare providers for non-

emergency concerns a**nd also payment system needed".** Telehealth encompasses a broader range of services, including remote patient monitoring, teleconsultations, and tele-education. These applications improve access to healthcare, particularly for individuals in rural or underserved areas.



*Fig 6. An image depicting a telehealth consultation S**ource: Google Scholar***

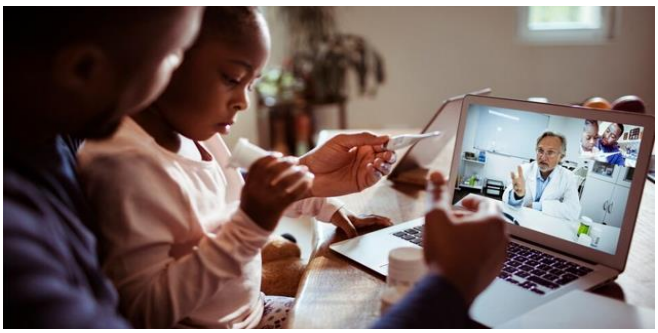


Fig 7. An image depicting a telemedicine consultation, illustrating how ICT enables remote healthcare delivery and improves access to healthcare services. Source: Academic database IJHISI, PubMed, Web of Science)

Health Information Systems: ICT supports the development and implementation of robust health information systems. HIS are critical and foundational in the drive of information and knowledge management for healthcare, Ayogeboh, et al., (2023). Electronic Health Records (EHRs) centralize patient data, allowing healthcare providers to access comprehensive information for improved clinical decision-making. Interoperable health information systems facilitate the secure exchange of health data between different healthcare settings, ensuring seamless care coordination and continuity.

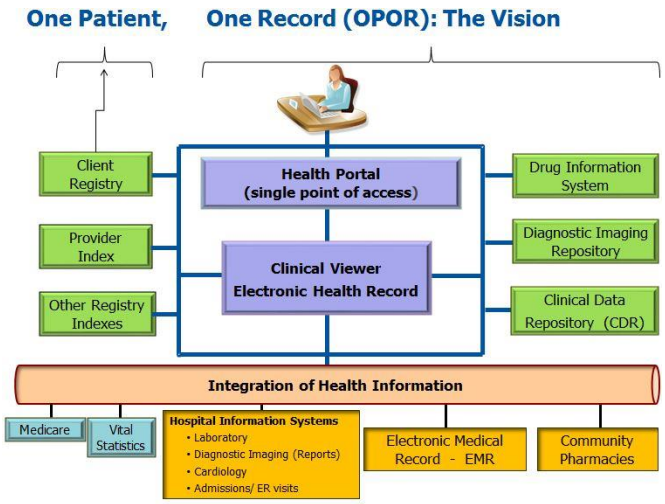


Fig 8. A visual representation of an Electronic Health Record (EHR) system, showcasing the integration and exchange of health information facilitated by ICT. (Source: www.hpspub.gnb.ca)

Mobile Health (mHealth) Applications: mHealth applications leverage mobile devices to deliver healthcare services, health information, and behavior change interventions. These applications enable individuals to monitor their health, access personalized health recommendations, track medication adherence, and engage in self-care practices. mHealth has great potential for promoting preventive care and empowering individuals to actively manage their health.

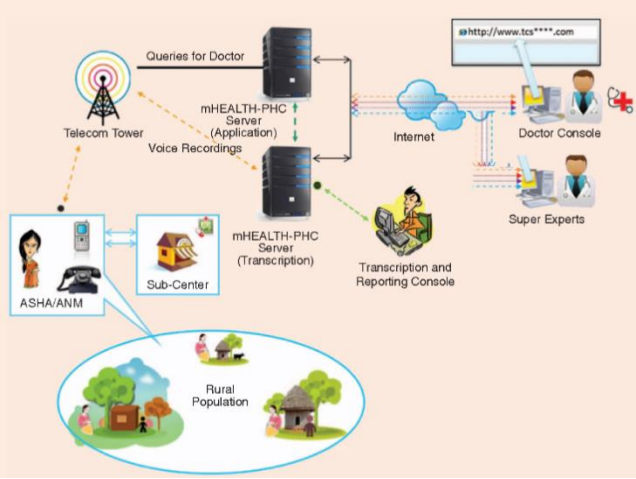


Fig 9. Components of the mHealth [PubMed]
An image showcasing various mHealth applications on a mobile device, highlighting the role of ICT in empowering individuals for self-care.

Health Education and Communication: ICT provides platforms for health education and communication. Websites, social media platforms, and mobile applications serve as channels for disseminating health information, raising awareness about health issues, and promoting healthy behaviors. Interactive digital tools engage individuals in educational activities, enhancing health

literacy and empowering them to make informed decisions

Benefits of ICT in Public Health Technology

The integration of ICT in public health offers numerous benefits, contributing to improved healthcare practices and outcomes. Some key benefits include:

Improved Data Accuracy and Accessibility: ICT tools enhance the accuracy and accessibility of health data. Digital data collection reduces errors associated with manual entry, and electronic databases ensure data availability and easy retrieval. This enables more reliable and evidence-based decision-making in public health.

Real-Time Disease Surveillance and Response: ICT enables real-time monitoring and early detection of disease outbreaks. This allows public health authorities to respond promptly, implementing appropriate measures to control the spread of diseases and mitigate their impact on public health.

Enhanced Communication and Collaboration: ICT promotes effective communication and collaboration among healthcare professionals, researchers, policymakers, and the community. Virtual platforms, email, and instant messaging facilitate instant communication, enabling timely sharing of information, expertise, and best practices. Collaboration tools support multidisciplinary teamwork and partnership building, leading to innovative solutions and improved public health outcomes. According to WHO, the use of ICT in a Primary Healthcare setting, has improved greatly communication between colleagues, enhanced access to information, facilitated continuous professional development Interprofessional collaboration using ICT may reduce the risk of death or admission to a hospital or nursing home among elderly home care patients in Japan. Takeru, et al. (2022)

Improved Healthcare Access and Delivery: ICT applications, such as telemedicine and mobile health, improve access to healthcare services, particularly for individuals in remote or underserved areas. Teleconsultations eliminate geographical barriers, enabling individuals to receive timely healthcare consultations and reducing the burden on healthcare facilities. A study carried out by Omona and Ikoja-Odongo (2006), according to Chimango, (2018), suggest that the use of ICTs improved accessibility, dissemination and quality of health information by presenting current information and data; eliminating geographical boundaries, source of up-to-date global information on health.

Empowerment of Individuals: ICT empowers individuals to actively participate in their own healthcare. Mobile health applications provide tools for self-monitoring, self-management, and health education, enabling individuals to make informed decisions about their health and engage in preventive care practices.

Efficient Resource Allocation: ICT enables efficient resource allocation in public health. Data analytics tools help identify areas of high disease burden, allowing for targeted allocation of resources, including healthcare facilities, personnel, and interventions. This optimizes resource utilization and enhances the efficiency of public health programs. With the aid of Artificial Intelligence and Machine learning, patterns and trends can be identified in resource utilization and in making predictions about the future needs.



Fig 10: An infographic illustrating the role of technology in resource allocation. [PubMed] [Google Scholar]

Improved Data Management and Analysis: ICT enables efficient and accurate data management in public health. Digital platforms and tools facilitate the collection, storage, and analysis of health data, eliminating the need for manual processes and reducing the risk of errors. This leads to enhanced data quality and accessibility, allowing public health professionals to make informed decisions based on reliable information.

Recommendations

By addressing these areas, we can harness to greater extent the full potentials of ICT to reposition public health technology development and practice, thereby improve population health outcomes.

1. Engagement with community leaders and stakeholders to ensure culturally sensitive ICT solutions.
2. Collaboration with industry experts to develop scalable and sustainable ICT solutions for the profession.
3. Foster partnerships between public health professionals, computer scientists, and engineers.
4. Encourage Open-source development of ICT solutions for public health technology.
5. Foster collaborations between healthcare professionals, technologists, and policymakers to drive innovations especially in Public health Profession

Conclusion

In conclusion, ICT applications have transformed public health practices and systems, offering numerous benefits. From data collection and analysis to telemedicine, health information systems, and health education, ICT has revolutionized healthcare delivery, disease surveillance, and communication in the field of public health technology. The effective integration of ICT empowers healthcare professionals, enhances decision-making, improves health outcomes, and ultimately contributes to the overall well-being of populations.

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