Exploring The Synergy Of Technology In Public Health-

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ABSTRACT-

The intersection of technology and public health has been brought in a new era of innovation, offering transformative solutions to address various healthcare challenges. Review explores the multifaceted role of technology in public health initiatives, encompassing digital health interventions, social media monitoring ,3D printing, data analytics, telemedicine, wearable devices, and artificial intelligence.

In recent years, the utilization of social media monitoring in the realm of public health has emerged as a powerful tool for surveillance, communication, and intervention strategies. It delves into how this approach enables the real-time tracking of disease outbreaks, identification of health-related trends, and monitoring of public sentiment towards health interventions and policies.

This review discusses the integration of social media data with traditional epidemiological surveillance, showcasing its potential in early detection, rapid response, and risk communication during public health crises, applications of wearable devices in public health research, disease monitoring, and early detection, emphasizing their role in facilitating remote patient monitoring and enhancing healthcare delivery.

Three-dimensional printing (3DP) enables the development of diverse geometries through computer aided design using different techniques and materials for desired applications such as pharmaceutical drug delivery medicine. The FDA approval of printed-medicine opens up an unprecedented opportunity for the discovery of new compounds and technologies for the pharmaceutical industry development. A new telemedicine health care model has emerged as a result of traditional healthcare model evaluation the ongoing advancement, of current network information technology and peoples desire for healthcare.

Technologies Use In Public Health-

Introduction:

In today's world, technology is transforming how we take care of public health. Imagine using computers to study lots of information about diseases, or talking to a doctor through a video call instead of going to the clinic. Wearable gadgets like smartwatches that track our health or

special tools that use super smart software to find out what's wrong with us – these things are making a huge difference.

These advancement are super helpful. They help us keep an eye on diseases, like how they spread or who they affect most. They also make it easier for everyone to get healthcare, even if they live far away from a hospital. Plus, these tools can make treatments better and faster, meaning people can get better quicker.

When we welcome these new technologies into our lives and healthcare systems, we're not just embracing fancy gadgets; we're working towards a world where everyone can be healthier. It's like building a bridge between technology and health, making it easier for people to live better lives and stay safe from diseases. By using these tools wisely and making them available to more people, we're all contributing to creating a healthier and happier global community.

Artificial Intelligence (AI) in Public Health:

AI offers immense potential in disease prediction, diagnosis, treatment optimization, and resource allocation. For instance, machine learning algorithms analyze vast datasets to identify disease patterns, enabling early intervention and personalized treatment plans (Suleiman et al., 2020). However, challenges persist, including data privacy concerns and algorithm biases (Topol, 2019)

- *Machine Learning*- Data Science and Machine Learning in Public Health: Promises and Challenges.Understanding complex connections between genetics, environment and disease.
- *Natural Language Processing (NLP)*-Behavior analysis through the social media and consumer generated data.
- *Natural Language Understanding (NLU)*- Prediction of Loneliness in Older Adults.
- *Natural Language Generation (NLG)*- Removing identifiers from electronic health records data.
- *Cognitive Search*- Search Engine to Evaluate and Analyze Information About COVID-19.
- *Digital decisioning platforms*-Decision-making through modeling and understanding of multiple variables and complex systems.
- *Robotic*- Disinfection of areas, Delivery of medications & food, Measuring of vital signs in the COVID-19 environment.
- *Virtual Agents(Chatbots)*-Healthy Lifestyle/Wellness, Mental Health, Reproductive Health, Weight Control and Smoking Cessation.Computer Vision-Medical imaging and predictive modelling for pulmonary medicine.
- *Deep Learning*- Deep Learning Algorithm for Detection of Diabetic Retinopathy in Retinal Fundus Photographs.
- *Speech Analytics*- Analysis of Human Behavior and States.de Nigris, S., Gomez-Gonzalez, E., Gomez, E., Martens, B., Iglesias Portela, M., Vespe, M. & Kotsev, A. (2020).

Challenges-

Data Privacy and Ethical Concerns: AI applications in healthcare raise concerns about data privacy, patient consent, and ethical use of patient data (Topol, 2019).

Algorithm Bias and Interpretability: Ensuring fairness, transparency, and interpretability of AI algorithms is crucial to prevent biases in decision-making (Topol, 2019).

3D Printing's Role in Healthcare:

The dream behind 3D printing is that medication will be tailored to individual in way that makes it safer and more effective.

The size, dose appearance and rate of delivery of a drug can be designed to suit an individual. 3D printing has enabled the creation of high dose rapid dissipation pills, affording doctor reliable customization and complete control over the speed and strength of delivered dosage.

The word "personalized medicine" is regularly described as providing "the right patient with the right drug at the right dose at the right time.(Shaikh Siraj, N., Jain Vrushabha, G., & GJ, K. 2019). The emergence of 3D printing has revolutionized healthcare by facilitating the production of prosthetics, medical devices, and even organ transplants. Its customization capabilities and cost-effectiveness contribute significantly to improving patient care and accessibility (Chang et al., 2018). Yet, regulatory frameworks and material quality standards remain critical hurdles (Ventola, 2014).

Application in Healthcare:

- *Prosthetics and Implants*: 3D printing allows for the creation of personalized prosthetic limbs, orthopedic implants, and dental devices tailored to individual patient needs. These customizations enhance comfort and functionality.
- *Surgical Tools and Models*: Surgeons can benefit from 3D-printed surgical tools, anatomical models, and organ replicas for pre-surgical planning, training, and simulation, improving surgical precision.
- *Tissue Engineering and Organ Transplants*: Researchers are exploring 3D bioprinting to create living tissues and organs using bio-inks comprised of living cells. This technology holds promise for organ transplantation and tissue regeneration.
- *Medical Devices*: Customized medical devices, such as hearing aids and prosthetic components, can be produced rapidly and cost-effectively using 3D printing technology.

Benefit-

Customization: 3D printing allows for precise customization, ensuring a perfect fit for medical devices and implants, improving patient comfort and functionality.

Rapid Prototyping: Healthcare professionals and researchers can quickly develop prototypes, enabling faster iterations in design and development processes.

*Cost Efficiency***:** In some cases, 3D printing can reduce production costs for custom medical devices compared to traditional manufacturing methods.

*Complex Geometries***:** It enables the creation of intricate structures that would be difficult or impossible to produce using traditional manufacturing methods.

Challenges:

*Regulatory Hurdles***:** Quality control, standardization, and regulatory compliance are critical challenges, especially concerning the approval and regulation of 3D-printed medical devices and implants.

Material Limitations: The range of materials available for 3D printing medical-grade devices and tissues is evolving but still limited compared to traditional materials used in healthcare.

Biocompatibility and Safety: Ensuring the biocompatibility and safety of 3D-printed materials within the human body is essential and requires thorough testing and validation.

Ethical Considerations: The ethical implications of 3D printing organs, tissues, or body parts raise questions regarding ownership, access, and equity in healthcare.

Social Media Monitoring for Public Health Surveillance:

The utilization of social media data for disease monitoring and outbreak prediction has gained traction. Timely detection of health-related trends through sentiment analysis aids in proactive public health interventions (Hansen et al., 2020). However, data accuracy, privacy issues, and misinformation management pose challenges (Denecke et al., 2015).

The widespread use of social media has provided health organizations with new opportunities to enhance telehealth, remote patient monitoring, and operations in general. Studies have shown that social media can be an efficient marketing tool to boost sales and revenue.

Health organizations such as hospitals, clinics, pharmaceutical companies, and community health centers use social media as a platform to promote their offerings, such as products and services, as well as their associations with reputable partners. Additionally, the prevalence of social media use among health organizations has made it important for them to maintain a presence on these platforms through the creation of social media profiles, as it serves as a signal to the market that the organization is active and operating .

In other words, social media has become a vital tool for health organizations to maintain their visibility and establish a positive reputation in the market.

Social media has expanded the ways in which health providers can communicate with patients and other stakeholders .

Health providers use social media to share information about treatments and services for specific diseases, educate the public about health issues, and stay in touch with patients . Additionally, doctors can use social media to promote their services and connect with potential patients . On the other side, patients use social media to gain health knowledge,

connect with other patients with similar health concerns, and access telemedicine and other online health services. These interactions between health providers and patients also provide valuable data for health organizations to improve their competitive advantage and perform in-depth data analysis. Social media serves as a new channel for data collection and communication in the healthcare industry. it is possible to build automated AI technologies to enable continuous monitoring. With these technologies, the health organization can continuously monitor systems and technologies for privacy risks, alerting organizations to any potential issues and helping them to take timely action to address them. Leung, R. (2023, June)

Telemedicine:

Telemedicine is a health-related service with the help of telecommunicating and electronic information technologies. It refers to thewhole collection of deliverables designed to enable patients and theirphysicians or healthcare providers.

It has a wide range of uses, including online patient consultations, remote control, telehealth nursing, andremote physical and psychiatry rehabilitation. It allows better health carechoices, increases emergency service quality and performance, reducestime in making a diagnosis, and saves costs for both doctors and patientsby optimising clinical procedures and reducing travel expenses to hospital. Telemedicine is a transformative aspect of healthcare that involves using technology to provide remote medical services and consultations. It leverages communication tools, such as video conferencing and mobile apps, to connect patients with healthcare providers, enabling diagnosis, treatment, and monitoring without requiring in-person visits.

Application Of Telemedicine-

- Telemedicine has improved the capacity of healthcare providers to take care of many people without physically being there.
- Telemedicine technology holds great promise for patients in remote areas.
- This technology allows people to take blood pressure medicine, refill medications, and recall their appointments.
- It is a cost effective.

Benefits of Telemedicine:

Accessibility: It improves access to healthcare, especially for individuals in remote areas or those with mobility constraints. Patients can receive medical advice and care regardless of their geographical location.

Convenience: Telemedicine offers convenience by reducing travel time and waiting periods. Patients can consult with healthcare professionals from the comfort of their homes, promoting better adherence to appointments.

Cost-Effectiveness: It often proves cost-effective for both patients and healthcare providers by minimizing travel expenses and hospital visits, leading to potential savings in healthcare expenditures.

Continuity of Care: Telemedicine facilitates ongoing monitoring and follow-ups, ensuring continuity of care for chronic conditions or post-treatment check-ups.

Emergency Consultations: It enables quick access to medical advice during emergencies, allowing immediate guidance or preliminary assessment before seeking in-person medical care.

Why Healthcare System Needs Telemedicine?

Rising healthcare costs and a need for better treatment are motivating more hospitals to investigate the benefits of telemedicine.

They want improved contact between physicians and far-off patients and better usage of healthcare facilities.

Here telemedicine also promotes better connectivity, which has resulted in fewer hospital re-admissions and patients entirely adhering to their prescription care plans.

Telemedicine's increased contact advantage extends to doctor-to-doctor communication as well. Doctors may use telemedicine to build support networks to exchange their skills and provide better healthcare services.

Telemedicine is a way of delivering medical treatment over the internet, usually through video.

Wearable Devices in Health Monitoring:

Wearable technologies enable continuous health monitoring, empowering individuals to track vital signs, physical activity, and overall wellness. These devices offer real-time data for early disease detection and lifestyle modification (Steinhubl et al., 2015). Nevertheless, data accuracy, interoperability, and user compliance require further attention (Vashist et al., 2020).

Types and Benefits:

Fitness Trackers and Health Monitoring Devices: Wearable devices like fitness trackers capture data on steps, calories burned, and sleep patterns (Steinhubl et al., 2015). They promote physical activity awareness, encouraging healthier lifestyles (Vashist et al., 2020)

Smartwatches for Comprehensive Health Tracking: Smartwatches combine fitness monitoring with additional features such as notifications and GPS, providing a holistic approach to health management (Steinhubl et al., 2015).

Health-specific Wearables: Devices like wearable ECG monitors aid in monitoring heart rhythms, facilitating early detection of cardiac irregularities (Steinhubl et al., 2015).

Benefits:

Real-time Health Monitoring: Wearables enable real-time tracking of health metrics, allowing for timely intervention and better disease management (Steinhubl et al., 2015)

Personalized Insights and Recommendations: Data collected by wearables offer personalized health insights, empowering users to make informed decisions for improving their health (Vashist et al., 2020).

Remote Patient Monitoring: Healthcare providers leverage wearables for remote patient monitoring, particularly for chronic conditions, enhancing healthcare delivery (Steinhubl et al., 2015).

Challenges-

Data Accuracy and Reliability: Ensuring the accuracy of wearable-collected data remains a challenge, especially for medical-grade measurements (Vashist et al., 2020).

Interoperability Issues: Integrating diverse wearable data into unified platforms poses challenges due to varying data formats and standards (Steinhubl et al., 2015).

Privacy Concerns: Safeguarding sensitive health data collected by wearables raises privacy and security concerns regarding storage, transmission, and access control (Vashist et al., 2020).

Sustaining User Engagement: Maintaining long-term user engagement and motivation for consistent use of wearables is critical for their effectiveness in healthcare (Steinhubl et al., 2015).

Conclusion:

The integration of AI, 3D printing, social media monitoring, and wearable devices has the potential to revolutionize public health. Addressing challenges related to privacy, regulation, and data accuracy is imperative to maximize the benefits of these innovations.

References-

Chang, J., et al. (2018). The past, present, and future of 3D printing in medical and surgical specialties. HealthCare, 6(1), 24. DOI: 10.3390/healthcare6010024

Denecke, K., et al. (2015). How to exploit twitter for public health monitoring? Methods Inf Med, 54(4), 326-336. DOI: 10.3414/ME15-01-0076

Hansen, C. M., et al. (2020). Social media mining for public health monitoring and surveillance. Health Information Science and Systems, 8(1), 1-12. DOI: 10.1007/s13755-020-00116-9

Steinhubl, S. R., et al. (2015). The era of digital medicine. European Heart Journal, 37(2), 154-161. DOI: 10.1093/eurheartj/ehv770

Suleiman, A. B., et al. (2020). Applications of artificial intelligence in battling against COVID-19: A literature review. Chaos, Solitons & Fractals, 142, 110338. DOI: 10.1016/j.chaos.2020.110338

Topol, E. J. (2019). High-performance medicine: The convergence of human and artificial intelligence. Nature Medicine, 25(1), 44-56. DOI: 10.1038/s41591-018-0300-7

Ventola, C. L. (2014). Medical applications for 3D printing: Current and projected uses. P&T: A Peer-Reviewed Journal for Formulary Management, 39(10), 704-711

Leung, R. (2023, June). Using AI–ML to Augment the Capabilities of Social Media for Telehealth and Remote Patient Monitoring. In Healthcare (Vol. 11, No. 12, p. 1704). MDPI.

de Nigris, S., Gomez-Gonzalez, E., Gomez, E., Martens, B., Iglesias Portela, M., Vespe, M. & Kotsev, A. (2020). Artificial Intelligence and Digital Transformation: early lessons from the COVID-19 crisis. M. Craglia (Ed.). Luxemburgo: Publications Office of the European Union.

Ref.   Steinhubl, S. R., et al. (2015). The era of digital medicine. European Heart Journal, 37(2), 154-161. DOI: 10.1093/eurheartj/ehv770

Vashist, S. K., et al. (2020). Wearable biosensors for health monitoring: A review. Journal of Electroanalytical Chemistry, 878, 114596. DOI: 10.1016/j.jelechem.2020.114596

Shaikh Siraj, N., Jain Vrushabha, G., & GJ, K. (2019). A review on 3d printing in pharmaceutical.