Health Innovations and Applications: A summary of creative data and analytical techniques

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Abstract

The past ten years have seen a rapid evolution of innovative data sources and methods for public health surveillance (PHS), indicating the need for a closer examination of the scientific maturity, viability, and practicality of use. The data from social media, internet search engines, the Internet of Things (IoT), wastewater surveillance, participatory surveillance, artificial intelligence (AI), and nowcasting are some of the recent innovations in PHS that are summarized in this article. By enhancing disease estimates, encouraging early warning for disease outbreaks, and producing more and/or more timely information for public health action, examples found indicate that new data sources and analytical techniques have the potential to improve PHS. AI is being used more and more to process vast amounts of digital data, and wastewater surveillance has resurfaced as a useful tool for early detection of the coronavirus disease 2019 (COVID-19) and other pathogens. Lack of scientific maturity, a dearth of real-world public health implementation examples, privacy and security concerns, and health equity implications are some of the obstacles to putting new approaches into practice. Important next steps for expanding the use of innovation include strengthening data governance, creating explicit guidelines for the use of AI technologies, and training the public health workforce.

Keywords: public health surveillance, innovations, analytical techniques.

1. Introduction

In order to guide actions to prevent and control diseases or improve population health, public health surveillance (PHS) is the continuous, systematic collection, analysis, and interpretation of data followed by the dissemination of information. In the past, PHS was carried out using a small number of data sources from laboratory, health care, and public health information systems in

addition to questionnaire-based surveys, which frequently take a significant amount of time and money to process, analyze, and distribute (Sahu, 2021).

The time lag, expense, and burden of performing PHS have decreased due to the digitization of the health care industry and other sectors. It has also made it possible to investigate alternative data sources to supplement conventional ones. Furthermore, during the past ten years, significant progress has been made in the field of artificial intelligence (AI). In PHS, the use of artificial intelligence- enabled techniques that effectively handle massive volumes of structured and unstructured data is growing (Lavigne, 2019).

During the COVID-19 pandemic, when timely and comprehensive information was essential to comprehending and adapting to changing pandemic risks, many of these data sources and AI techniques were used. The quick development of these cutting-edge surveillance techniques and the utilization of new data sources point to the necessity of examining their scientific maturity as well as the viability and practicality of their application in practical settings. In addition to giving public health authorities information on the possible advantages, dangers, and difficulties of utilizing non-traditional data sources and methods in PHS, this paper aims to highlight instances of the application of innovative methods to PHS (Morgenstern,2021).

An overview of PHS data and analytical method innovations published in the last five years is given in this article, along with any proof of their practical application, ethical considerations, and known health equity implications. Every innovation is explained, along with its degree of scientific maturity and, if available, any proof of how it has affected public health initiatives or surveillance practices.

2. Opportunities and Challenges:

PHS innovations over the last ten years have been examined in this review, along with instances of how they have been applied to PHS programs where feasible. Providing new information that enhances disease estimates, encouraging early warning and identification of possible health risks, and producing new information for public health action are a few examples of how these innovative sources are used to support PHS.

Notwithstanding these advantages, putting PHS innovations into practice presents significant obstacles. With the aim of enhancing general population health, the advantages and disadvantages of new data sources and techniques should be evaluated as they are added to the PHS toolkit. The majority of the topics covered in this paper lack scientific maturity and are frequently so new that there are currently no best practices or standard procedures to help them develop in a responsible and reliable manner. Numerous innovative techniques mentioned in this paper were evaluated in scholarly settings without a clear plan for practical application (Zeng, 2020).

More real-world assessments of these interventions are required to determine their effectiveness in enhancing PHS and their implications for public health initiatives. To assist public health organizations in putting new techniques into practice, these assessments could be used to create and distribute guidelines and standardized practices (Francombe, 2022).

3. Digital Technologies and AI in PHS:

The application of AI and digital technologies in PHS also raises issues with data governance, privacy and security, and ethics. For instance, the advantages of having a lot of detailed data for analysis must be balanced with the requirement that people cannot be (re)identified. Given the vast amount of data typically needed to train the model, this is especially true with AI techniques (Aiello, 2020).

It is unclear how or whether informed consent can or should be obtained in the case of digital data that may be publicly available but for which authorization to use for surveillance purposes has not been obtained. Extra caution must be used to guarantee that data are anonymized and that private information is kept hidden. To fully operationalize these data sources, progress toward digital data governance is required. Public trust and the sustainability of these systems depend on the protection of digital data and transparency in the collection, storage, and use of data. Guidelines for the use of AI in general as well as ethical frameworks for the use of AI and social media data in research have been developed to encourage responsible behavior and safeguard the privacy of those whose data is collected (Pilipiec, 2023).

4. Health Equity :

When putting new surveillance techniques into practice, health equity must be taken into account. Several examples of strategies that could be employed to promote health equity were found in this overview because they target populations that conventional surveillance might overlook. However, a recent review article pointed out that no studies specifically addressed vulnerable populations when using digital PHS, indicating that further research is required to examine the implications of its use for health equity. In order to make sure that AI algorithms and the data they are trained on are not producing harmful results as a result of biased inputs, more effort must be put into investigating, identifying, and addressing biases in both (Johnson, 2020).

5. Recommendations:

It should be noted that this overview has limitations. The purpose of this article was to examine real-world application examples and give a brief overview of recent advancements in PHS. As such, it is not meant to be a comprehensive list and is unable to offer a thorough evaluation of these innovations' efficacy. The article may have missed articles from applied public health settings that were published as grey literature because it only focused on peer-reviewed literature. A positive publication bias might have also resulted from the use of peer- reviewed literature, as studies pointing out unintended consequences or negative outcomes might not have been as well-represented. This is a crucial factor to take into account because non-traditional data sources can also contain false information about public health and should be carefully considered and assessed before being used.

6. Conclusion:

Although new PHS data and techniques have the potential to increase the amount, precision, comprehensiveness, timeliness, and accessibility of information available for public health response, there doesn't seem to be enough evidence to support their applicability in real-world settings as opposed to academic ones. The adoption of new data and techniques in PHS is hampered by significant obstacles, which range from training and data and technology availability to ethical, privacy, and health equity issues. Important next steps to promote increased use of innovative techniques and data sources include strengthening data governance procedures, creating explicit guidelines for PHS's ethical use of AI technologies, and educating the public health workforce on how to use cutting-edge technologies responsibly.

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