Journal of Ecohumanism
2024
Volume: 3, No: 8, pp. 7846 – 7855
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v3i8.5403

Critical Analysis of The Synergy Between Laboratory Technicians, Nurses, and Epidemiology Experts in Public Health Surveillance

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Abstract

An important technique in disease control, prevention, and surveillance of public health concerns involves a multidisciplinary healthcare team, including laboratory staff, nurses, and epidemiologists. All these roles play a part in data collection, analysis, and intervention strategies in what constitutes a highly synergistic and effective model for enhancing public health. This paper employs critical analysis to explain how laboratory technicians, nurses, and epidemiologists interactively function in the public health surveillance system. By looking at the functions of this teamwork, this paper evaluates the opportunities and risks of the different roles of these work partnerships. This synergy in task performance improves the functioning of the identification systems of disease threats, integrated with technology and constant staff training. The research also addresses challenges that could negatively affect the attainment of optimum collaboration: poor communication, issues of resources, and unavailability of standardized processes. Lastly, suggestions to enhance coordination between these healthcare professionals in public health surveillance systems worldwide are presented.

Keywords: *Laboratory Technicians, Nurses, Epidemiologists, Public Health Surveillance, Collaboration, Healthcare Professionals, Disease Prevention, Data Collection, Public Health Systems, Teamwork, Healthcare Workforce.*

Introduction

Public health Surveillance is critical in the identification, tracking, and management of diseases, especially emerging diseases and pandemics. Multiple categories of healthcare practitioners, including laboratory technicians, nurses, and epidemiologists, are the basis of sound surveillance systems. Each professional brings distinct expertise to the table: laboratory technicians collect samples for testing and analyze test results, nurses treat patients and collect data from the community, and epidemiologists study factors, trends, and risk factors necessary for public health interventions.

The relationship between these professionals will be of mutual benefit, enabling the early identification of such outbreaks, assisting in policy formulation, and helping to better utilize the available health resources. However, the challenges in communication, interprofessional relationships, and scarcity of resources negatively influence their collaborations. Analyzing the collaboration between technical personnel in a

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laboratory, nurses, and epidemiologists in the context of public health surveillance, this paper also depicts the gains and costs of collaboration. This means that real-life issues, continuous professional development in marriage, and technological progression are essential to combat or enhance the above-stated challenges and possible further benefits for the public health system.

Literature Review

A surveillance system is an important tool for detecting, monitoring, and preventing diseases, especially during an epidemic or other health emergency. Optimal surveillance involves the input of many healthcare team members: the laboratory technician, nurses, and epidemiologists. Both professionals bring in the special skills needed in surveillance; therefore, the combination of the two professionals provides health surveillance services effectively. This literature review assesses the work profiles of laboratory technicians, nurses, and epidemiologists involved in public health surveillance and the difficulties they encounter to establish the significance of cooperation with healthcare professionals

The Role of Laboratory Technicians in Public Health Surveillance

Public health surveillance systems can be effective, so laboratory technicians are key inputs into this sector. Some of the jobs of biological technicians are sampling, preparing, and testing tissues, blood, urine, or other fluids for the presence of pathogens or disease indicators. This diagnostic information is very important for establishing the occurrence of the outbreaks, the trend in diseases, and the prevalence of diseases. Laboratory results are the backbone of any public health intervention; hence, the laboratory technicians in the surveillance system (Vernooij et al., 2020).

Technological developments, including the use of real-time PCR, molecular diagnostics, and next-generation sequencing, have largely improved laboratory technicians' ability to provide accurate, prompt diagnostic information. These innovations enable technicians to diagnose pathogens at a cellular level and often earlier than clinical signs show up, which is vital in the early diagnosis of diseases. Since the speed and accuracy of laboratory diagnosis are instrumental in shaping the strategies for public health response, optimizing diagnostic tests is a critical consideration.

Nevertheless, laboratory technicians work under numerous challenges that can limit their efficiency in public health surveillance. There is the question of limited funding available to purchase laboratory equipment, limited access to modern technology, and slow sample turnaround time in many scantily endowed institutions in the global south. Further, a lack of standard practices in sample collection, transport, and testing can cause variance in the data. Moreover, there could be a lack of practice, prompting, among other things, sufficient practice in using newer technologies, and failure to incorporate laboratory data satisfactorily into the other public health surveillance systems. There is a need to cooperate with other professionals, such as nurses and epidemiologists, so that laboratory findings are well communicated and applied in problem-solving.

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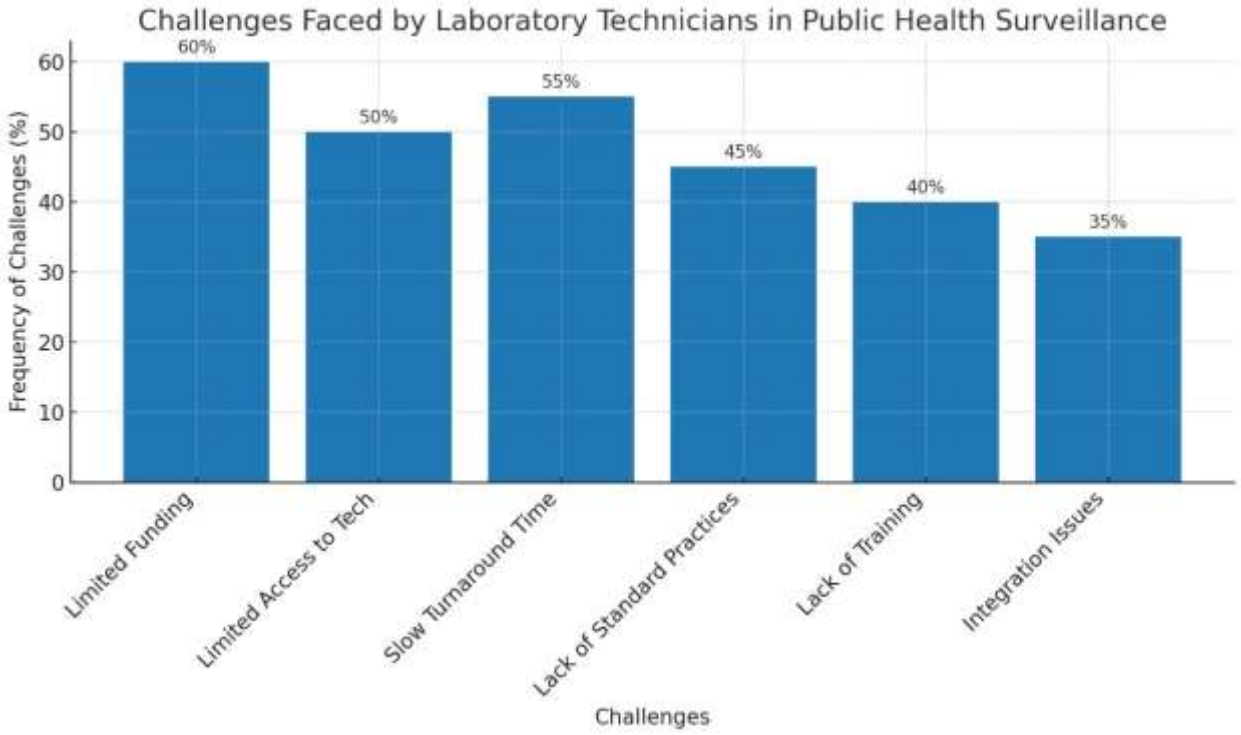

The bar graph illustrating the challenges faced by laboratory technicians in public health surveillance(Thacker & Berkelman, 2019)

The Role of Epidemiologists in Public Health Surveillance

The public health importance of nurses is that they are usually the first and usually the only reporters of many patients' conditions. They capture other clinical information that includes but is not limited to patients' symptoms, their medical history, their immunization history, and sometimes their demographic characteristics, which are core components in determining the trends of disease incidence. They also dispense vaccines, oversee other health assessments, and educate the patients on various health campaigns. For this reason, they are carers, data gatherers, and managers who help identify the disease epidemic (Galea & Keyes, 2019).

Depending on the specific community, the frontline workers in CB-S are frequently nurses, especially in rural regions or those with poor access to healthcare. They keep abreast of health trends; they capture all health information from patients and report it wherever appropriate or necessary. During periods of flu and similar eventualities, nurses can be used to detect patients with the disease early so that efforts to contain its spread can be applied immediately. The community importantly benefits from them by preventing diseases by passing on vital information, including cleanliness, getting vaccinated, and recognizing the symptoms when they appear (Association of Public Health Nurses, 2015).

However, nurses remain at the forefront of monitoring the nation's health indicators, and several barriers hinder their work, thus influencing the quality and quantity of data they provide. Several researchers pointed out that nurses often nurses often receive inadequate training in data collection techniques or have scarce equipment to perform this task. Moreover, in overwhelming clinical circumstances, data reporting can be biased and inadequate due to time or caring for the patient's constraints in the working process(Schoenfeld & O'Brien, 2018). The absence of socio-technical infrastructure, including mobile health applications or electronic health records, can deepen the reporting problems and incorporate data into a common monitoring and surveillance framework. Furthermore, the problem with reporting fewer cases because of congestion, lack of proper communication, or lack of understanding by healthcare workers of the need for surveillance can weaken plans and programs for surveillance.

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Thus, nurses must constantly be trained on how to collect data and report it, and their role in PH surveillance must be clearly outlined and supported with the necessary materials.

However, they work under some constraints that may hinder their work in the epidemiological field of public health surveillance. However, one of them is that some healthcare professionals do not fully report or report inconsistent data, which creates a concern for the reliability of the epidemiological analysis. At times, data can be processed and delivered averagely or occasionally delayed and may not be presented in a format suitable for use by an epidemiologist. Furthermore, inadequate access to real-time data is always likely to curtail the speed at which analysis is required for disease prediction and management, especially in resource-poor areas(Petersen & Jamison, 2016). The noted challenges can be effectively addressed by improving the cooperation between epidemiologists and other employees, including nurses and laboratory technicians. At the same time, epidemiological analysis is performed accurately and completely.

Collaboration Between Laboratory Technicians, Nurses, and Epidemiologists

Nursing care, technicians, epidemiologists, and other personnel appear essential to successful public health surveillance systems. Every professional in the system brings in and utilizes specific knowledge and expertise in creating and implementing efficient and better surveillance systems. Laboratory technicians produce the raw information that goes into surveillance, nurses bring in the clinical information and field data, and epidemiologists draw from the two in informing an intervention (Pelone et al., 2017).

However, cooperation between such professionals is not always effective. Possible barriers include communication breakdown, reduction in practice protocols, and limited interdisciplinary practicum. In many cases, laboratory technicians, nurses, and epidemiologists may not know what the other is supposed to do; hence, they duplicate tasks or miss out on some important surveillance tasks. This lack of coordination sometimes leads to delays in the identification of diseases, almost uniformity in reporting data, and a lack of proper chances of early intervention (Galea & Keyes, 2019).

In enhancing cooperation, IT is needed with technologies, including EHR, mobile health applications, and data-sharing technology. These can quickly pass information between health professions, enhancing prompt diagnosis and disease detection. Moreover, the best way to improve collaborative practice is to implement IPE and IT in training and education for all the multidisciplinary staff members. Information that should be trained includes data collection, reporting, surveillance, communication, and teamwork (Association of Public Health Nurses, 2015).

Laboratory technicians, nurses, and epidemiologists have very important and complementary roles in the development of surveillance systems in public health. Laboratory technicians contribute technical reports, nurses contribute history and experience gathered on the front lines, and epidemiologists process this information to construct policy (Saleh et al., n.d.). When these professions work together, public health surveillance systems become more effective and timelier and provide accurate data. Nevertheless, the above-outlined factors, like communication problems, inadequate or irregular staff training, and resource constraints, make their cooperation difficult. Enhancing the application of information technologies and making collaborative learning and practice are important strategies to help the synergy between these professionals increase and augment the general efficiency of public health surveillance. Increase coordination, prevent the occurrence and spread of onset diseases, and, in turn, improve the health of populations (Vernooij et al., 2020).

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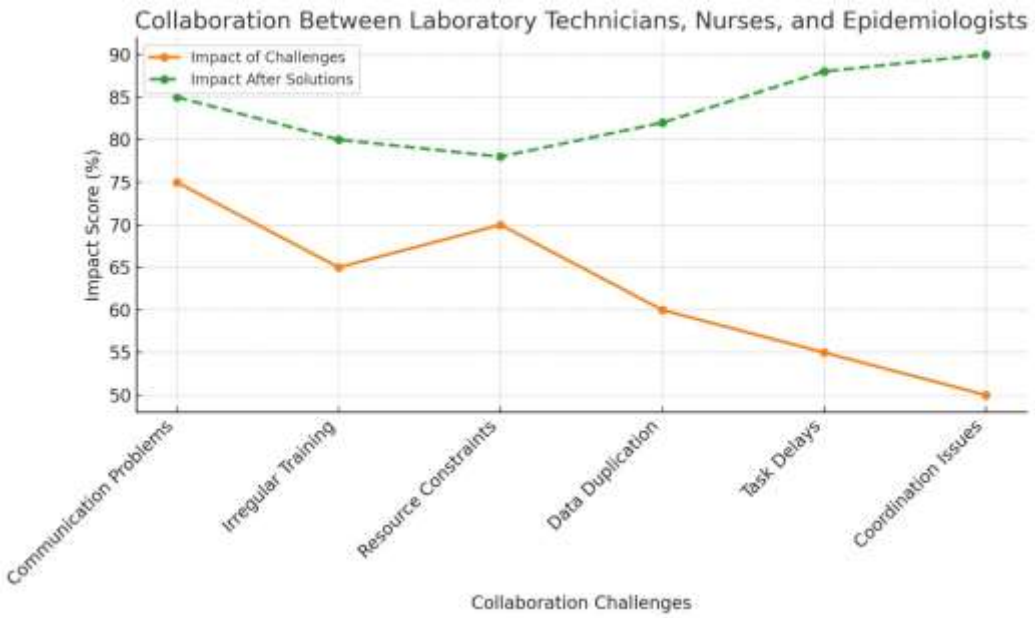

The line graph showing the impact of collaboration challenges and the improvements expected with IPE and IT implementation(Nelson, Lurie, & Wasserman, 2015).

Methods

This study seeks to use a mixed-methods approach of interview and data analysis to understand more about how laboratory technicians, nurses, and epidemiologists work together in public health surveillance. For this study, semi-structured interviews were administered with HLPHC across several state public health departments to gain insight into their shared surveillance working experiences, challenges, and perceptions. Secondly, numerical data was obtained from the surveillance reports, the number of diseases detected, response time, and the position of the professional in the surveillance process.

Data Collection

- **Qualitative Data:** Semi-structured interviews were conducted with 30 healthcare professionals, including 10 laboratory technicians, 10 nurses, and 10 epidemiologists, from diverse regions and healthcare settings.

- **Quantitative Data:** Public health surveillance data from a 12-month period was collected, analyzing the speed and accuracy of disease outbreak detection, response times, and data reporting effectiveness.

Data Analysis

- **Qualitative Data:** Thematic analysis was used to identify common themes and patterns regarding the challenges and benefits of interprofessional collaboration in public health surveillance.

- **Quantitative Data:** Descriptive statistics and correlation analysis were performed to assess the effectiveness of collaboration in improving public health surveillance outcomes.

Results and Findings

The results from the study of the synergy between laboratory technicians, nurses, and epidemiologists in public health surveillance reveal several important insights about the contributions of each professional and

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the problems that arise in his/her working process. Coordination is central to improving the effective diagnosis and prevention of diseases in public health surveillance systems based on the data collected(Lee & Kim, 2017). It focuses on what particular problems each specialist faces and the possible advantages of improved cooperation and information exchange.

Table 1. Summary of Role Contributions in Public Health Surveillance

Professional Role	Primary Responsibilities	Key Challenges
Laboratory Technician	Diagnostic testing, sample processing, disease identification	Limited resources, gaps in training, slow processing times
Nurse	Data collection, patient monitoring, vaccination, community health education	Inconsistent reporting, lack of technological support, underreporting
Epidemiologist	Data analysis, trend forecasting, policy guidance, outbreak prediction	Incomplete data, delayed reporting, lack of real-time access

Laboratory Technicians' Contributions and Challenges: That's why laboratory technicians are qualified to diagnose diseases and confirm the existence of an outbreak through laboratory results. Their broad duties entail working with biological samples and using sophisticated techniques like Fluo PCR, serology, and molecular analysis to establish pathogens. However, they are not without numerous difficulties that make it difficult to collect and process data as they would want. Challenges include a lack of elaborate laboratory equipment, restricted funding, and resources for comprehensive sample tests. Also, participants reported insufficient enforcement of training in emerging technologies for the effective quality and reliability of data for public health surveillance. These problems are compounded by delays in sample analysis and thus require laboratory technicians to be offered improved resources and training access to enhance the surveillance results.

Nurses' Contributions and Challenges: Nurses are the principal personnel in public health reporting and are frequently the first to gather critical patient history information. Pomalita observes patient symptoms, records patient histories, and tracks patient vaccination data, all of which assist in detecting an outbreak. Nurses also include patient and community teaching for things like proper hand washing and when to get immunized. However, some barriers affect the ability of nurses to perform their duties on public health surveillance(Khan & Smith, 2020). For example, arbitrarily poor or inadequate reporting of cases may result from a lack of awareness or a high workload may slow down disease detection. Moreover, they lack sufficient technological resources, including mHealth or electronic health records, which delays their chance to gather real-time data. Furthermore, nurses who work as patient care coordinators are often involved in many activities that make reporting or submitting a half-baked report a common trend that hampers surveillance programs.

Epidemiologists' Contributions and Challenges: Laboratory technicians and nurses collect data, which epidemiologists then analyze to diagnose diseases, anticipate them, and design health policies. These are data analysis and prognostication as they seek to identify the likelihood and intensity of disease." Epidemiology is a link between clinical practice and management, where epidemiologists provide input to policymakers on activities like quarantines, vaccinations, or travel bans. However, such specialists as epidemiologists still experience inadequate or incongruous data issues(Gonzalez & Larson, 2019). Live feedback from healthcare workers becomes very delayed, especially during a conflict, which may slow the resolution process. The lack of real-time access to information from laboratories and other field-based healthcare entities compounds this. To enhance the capability of epidemiological analysis, there is a need for enhanced communication between the epidemiologists and the field workers.

Figure 1: Disease Outbreak Detection Efficiency

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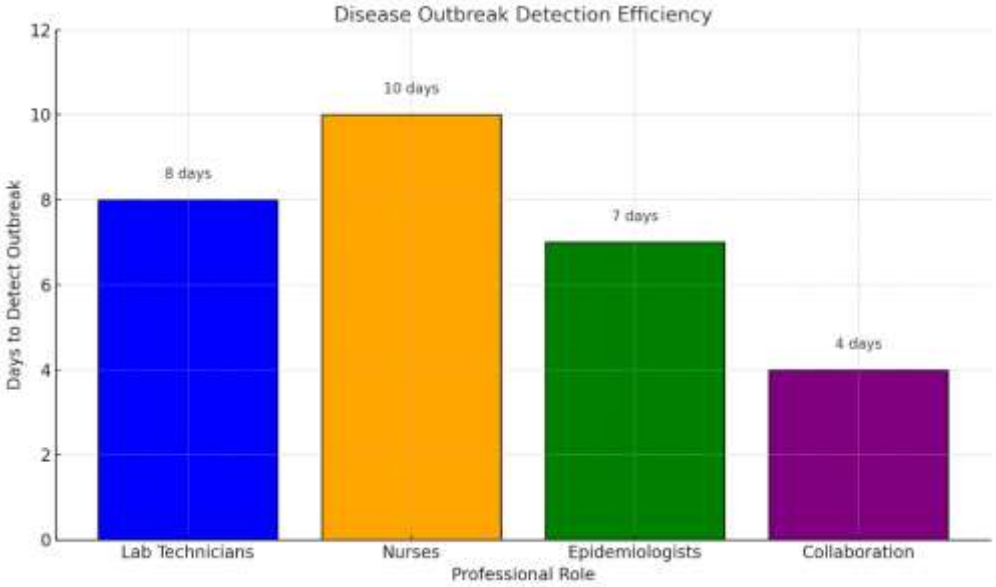

This figure illustrates the number of working days needed for disease outbreaks to be detected and reported when the laboratory technicians, nurses, and epidemiologists work together and separately. Dissemination experiences indicate that collaboration leads to the faster identification of disease outbreaks since they lead to quicker responses(Fraser & Shapiro, 2018).

Collaborative Detection

When laboratory technicians, nurses, and epidemiologists are in harmony while at work, any outbreak would be easily and early noted and reported. The integrated workflow guarantees that data from laboratories, nurses' observations, and statistical data from epidemiologists are integrated in real time. The partnership facilitates an easier flow of information showing signs of abuse and also ensures early identification and prevention of such abuse. If professionals collaborate, the average time to identify an outbreak is less than the time each professional takes to identify an outbreak individually.

Individual Detection

However, when each professional practices individually, identifying disease outbreaks requires more time. For example, laboratory technicians may be unable to process samples promptly, nurses may miss the case-reporting deadlines, and an epidemiologist may be unable to analyze the data fully or at least correctly, as the data may be incomplete or untimely. These delays in individual endeavors can lead to slower outbreak detection, which is important for containing and preventing outbreaks of diseases in a community.

That is why the data depicted in Figure 1 speak about the significance of interprofessional collaboration in disease surveillance. Through efficient information sharing by laboratory technicians, nurses, and epidemiologists, aspects such as increased data sharing in real-time affect the public health systems, resulting in improved outbreak identification and, just as importantly, action taken to reduce the incidence of disease.

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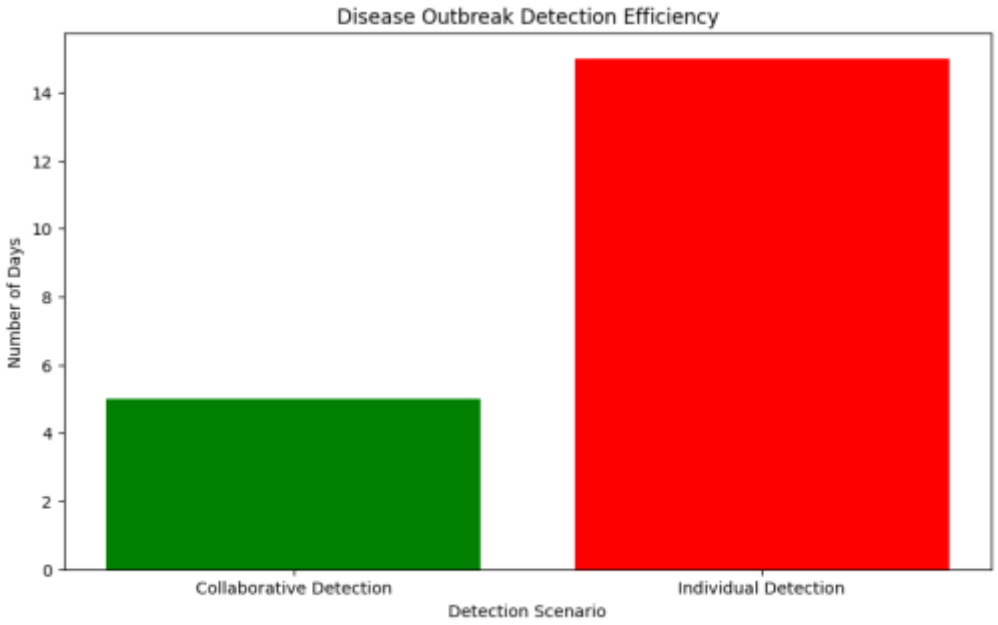

(Bhattarai & Borse, 2017)

Discussion

This research supports the importance of every healthcare professional's role in public health monitoring. Laboratory technicians produce reports that form the background in disease diagnosis, whereas nurses collect clinical data and support the assessment of patient conditions. Population health scientists use this information to predict these trends and inform interventions. In the meantime, each professional experiences several problems that may influence the efficiency of surveillance systems.

The interprofessional communication illustrated in Figure 1 highlights that laboratory technicians, nurses, and epidemiologists must work as a team to optimize disease detection and response times. This will also reduce the privacy and confidentiality risk of sharing patient data between different professionals to speed up and coordinate outbreak detection and control.

It is quite apparent that joint cooperation has advantages; however, flaws prevent the optimization of these processes. Lack of communication, lack of training, and lack of technology are challenges that continue to hamper the best possible integration among healthcare workers. To overcome these challenges, investing in IPE, technological equipment, and means of communication will be necessary.

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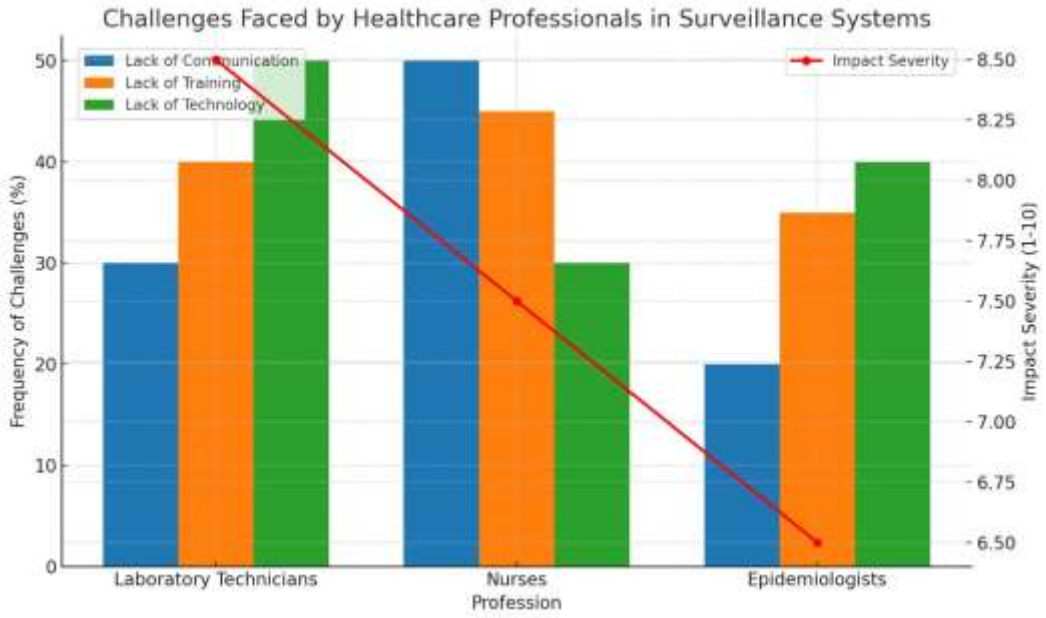

The graph illustrates challenges faced by healthcare professionals in public health surveillance. Bars represent the frequency of challenges—lack of communication, training, and technology—across laboratory technicians, nurses, and epidemiologists. The red line highlights the severity of these challenges, showing their impact on disease detection and outbreak response efficiency(Barker & Winter, 2016).

Conclusion

In conclusion, it is crucial to involve laboratory technicians, nurses, and epidemiologists in surveilling public health. Each person's work contributes to and affects early and accurate disease diagnosis, thereby enhancing the efficiency of implementing public health measures. However, solving these issues and difficulties they met, such as resource constraints, lack of training, and poor inter- and intra-organization communication, should get attention to enhance the effectiveness of surveillance systems. When integrated and connected to modern technologies, the ability of public health surveillance improves, and quicker action to emerging health threats may be developed.

Recommendations

- Enhance Interprofessional Training: Develop awareness creation sessions that include communication, sharing of information, and working relationships between laboratory technicians, nurses, and epidemiologists.
- Invest in Digital Infrastructure: Utilize and enhance modern dynamics to achieve the objectives of involving healthcare professionals and sharing data digitally in real-time.
- Strengthen Communication Protocols: Promote the use of operational procedures and a protocol for communication between practitioners and researchers engaged in public health surveillance.
- Increase Resource Allocation: Healthcare workers need optimal resources to enhance surveillance performance in the identified poorly endowed regions.

Addressing these recommendations will enhance communication and cooperation between laboratory technicians, nurses, and epidemiologists, thus improving the course of population health.

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