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Multidisciplinary Collaboration to Enhance Public Health Response: Insights from Nursing, Medical Information, Laboratory, Radiology, and Pharmacy

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1. Introduction to Multidisciplinary Collaboration in Public Health

In the current climate of health reform, an intersection of disciplines has been a focus in identifying ways to improve health care, as well as to address specific needs of a patient population. In public health, collaborative efforts are needed to address health disparities, requirements specific to various communities, and emergency care. In the context of public health, each of the medical disciplines, as well as pharmacy and medical information, brings specific strengths concerning knowledge, skills, and abilities. This text describes how a multidisciplinary approach to public health collaboration enhances community health and patient care. Members of a small community-based public health information program, who possess experience in nursing, medical information, radiology, laboratory science, and pharmacy, share insights on successful collaborations. These discussions provide a picture of

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the processes by which a community-based public health program is able to enhance patient care, engage community members, and address the needs of a pediatric patient population.

The mission of the public health information program described here is to facilitate information flow between health care providers and public health facilities, enhance health information exchange between multiple care settings, and support public health program development and evaluation. The program is designed to maximize involvement in local decision-making processes; protect patient confidentiality; deliver information at the right time, using a multidisciplinary approach to enhance community health and patient health; and reduce duplication of services. Through a collaborative relationship with a community-based children's hospital, the program has made significant inroads in improving information availability. Strategies for managing information traffic include clearly defining the role and function of each position at the confidentiality agreement, work rules, and processes which encourage adherence to these rules.

Methods

This perspective details, across five disciplines (nursing, medical information, laboratory, radiology, and pharmacy), the required collaboration for a successful public health response. The scenario presented is related to a failed public health response to the exposure of easily transmissible dangerous pathogens among over 50,000 people at two fairs in the western United States that resulted in 1,600 infections (32%). Over 200 people developed encephalitis, hypoxia, or respiratory failure, and 35 people died.

1.1. Definition and Importance of Multidisciplinary Collaboration

A multidisciplinary health care team involves health care professionals who are recognized as distinct disciplinary specialists or experts. A multidisciplinary team may not necessarily have a defined common purpose or objective for an individual patient or patient populations. A shared single or common goal that requires the contribution of all members, through active participation in and interaction with the team, is a prerequisite to forming an interdisciplinary health care team. Interdisciplinary collaboration is an approach to health care that seeks to facilitate multi- and single-disciplinary member contributions through shared decision-making and problem-solving processes to achieve previously shared, mutually objective health care goals. These collaborative health care professionals need to share accountability, responsibilities, and rewards for a patient's outcome, with respect to their specific needs and roles.

The majority of research on health care professional teamwork has largely focused on identifying barriers to achieving it within traditional health care settings. These studies have emphasized that health care professionals need a systematic, formal approach to learning about the roles and responsibilities of other members of the health care team and about the

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importance of working together using knowledge, expertise, and skills to improve patient care. As a matter of fact, nursing or medical schools and professional practice organizations have recommended enhancing teamwork and interprofessional collaborations through continuous, lifelong multidisciplinary contributions as a way to predict the success of medical, nursing, and allied health care education curriculums or clinical practices. This is to ensure that future graduates develop the skills, behaviors, and attitudes that enable them to collaborate with their team members. This collaborative practice provides high-quality care for patients and maintains their health by preventing diseases.

2. Roles and Contributions of Nursing in Public Health Response

The role of primary healthcare providers in public health surveillance is mainly based on their contextually appropriate public contact. Occurring during individual encounters with patients, it impacts readiness for emerging events, promptly detects such events, provides an entry point to additional public health response activities, and is engaged in outbreak preparedness or new insights derived from public health changes. In this regard, the public health-relevant roles of various healthcare providers, particularly those who interact with patients, should be clearly defined and integrated into a multidisciplinary engagement framework. Public health threats such as pandemics raise concerns about appropriate health service adaptations in response to such a large-scale event. Nurses are deeply involved in direct patient care, in addition to their contributions as care coordinators and facilitators to support patient recovery. However, the valuable role of nursing could extend beyond traditional health service facilities to support local responses to public health events. The collective observations and insights shared by nurses in clinical practice, as well as those in response to outbreaks, could enrich public health response through broader representation and insights from the professional group. Concentrated collaborative efforts led to a quicker and more efficient response to infectious disease outbreaks where nurses actively participated in the required response protocols to ensure effective preparedness.

2.1. Primary Responsibilities of Nurses in Public Health

Despite the variation in how and who defines public health nursing, it is clear that the 'public' is the community or population within which nursing care or service is provided. Like the Orientation of Public Health Nursing document, with its focus on health determinants, it is evident that an environmentally oriented, rather than institution-focused, model informs public health nursing practice. Evidence in the literature consistently reveals that this is the case, as it documents community, demographic, epidemiological, and social trends being used as cues in the response by public health nurses to community health problems and needs. Returning to philosophic foundations that focus on the common good as the basis for collective good, health protection, or promotion of the people, it is clear that public health is not simply the prevention of the spread of disease, however worthy that goal may be, but

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rather it can best be subsumed within a larger commitment to the delivery of population-based nursing care. (Jackson et al.2020)(Papadopoulou et al.2020)

The evidence indicates that the health of individual clients in community-based nursing agreements is inextricably linked to the health of the defined populations. It is clear that although the employment setting of nurses can shape the ways in which community-based health is addressed, it is when nurses participate in practice defined by the members of the population as a whole that the full power of public health nursing is realized. It is also clear from the general statements that, in addition to content derived from the major contents of other community content areas in public nursing, such as epidemiology, public policy, health planning, and health promotion, public health nursing has a primary service delivery role in nursing care, case management, and health counseling or coaching at the community level.

3. Medical Information Management in Public Health

Introduction To dissociate and manipulate the multidisciplinary expertise within the health care system will be paramount after a catastrophic public health crisis. This chapter addresses how professional expertise in health can build a deeper understanding of vital public health issues, be stronger contributors to public health, and collaborate more effectively in a time of disaster and public health crisis. The five health care disciplines—nursing, medical information management, laboratory, radiology, and pharmacy—provide commentary about their part in public health crises and global disaster response. The challenge within each chapter is to align the professional expertise within the chapter and to reveal how all are contributing to health care service during the chaotic period following a catastrophic crisis. (Gollust et al.2020)(Bauchner & Sharfstein, 2020)

Information Management and Public Health Disasters Information management during a public health disaster can break down and be overwhelmed as the disaster unfolds. Disaster-related systems can overwhelm healthcare systems through excessive volumes of patients or casualties requiring treatment or decision-making and the need for ongoing situational awareness. Each of these effects begins with an informational overload as the population seeks, expects, and craves public health and individualized guidance and support from their governmental agencies. When these expectations are only partially met, the individual or community can suffer additional stress and even worsened sequelae. Successful situations usually occur when government agencies accurately forecast, release information that is timely and necessary to respond, and facilitate their citizens' engagement. Governmental ability to meet their citizens' health information demand during a catastrophic public health event will be instrumental in moving forward and exhibiting strength and leadership during a slow and painful recovery.

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3.1. Role of Health Information Technology in Public Health Response

Health Information Technology (HIT) includes electronic health records (EHRs), health information exchange (HIE), and telehealth. The unprecedented crisis brought by COVID-19 has emphasized the importance of HIT in ensuring that data can be used to its fullest potential. There is an urgent need to make full use of the EHR to capture all aspects of the care given so that those with critical conditions requiring hospitalization can be more easily identified, and that research and implementation science can advance best care practices using the Learning Health System framework. The COVID-19 pandemic also points to gaps in the use of EHR capabilities. Public health responders are hindered by the lack of case ascertainment in EHRs and the lack of linkages across health entities within communities and nationwide, resulting in a lack of data to optimize resource allocations and hinder the current ability to understand hospital capacity constraints and COVID-19 transmission patterns. (Poulos et al., 2021)(O'Reilly-Shah et al.2020)

The Health Information Exchange (HIE) tightens linkages between various care-providing entities within communities and nationwide. Multiple approaches to HIE include data elements required for HIE implementations. Telehealth has become a vital tool in the care and protection of COVID-19 at pharmacies, medical offices, and homes. The increased utilization of EHRs and consumer wearables brings new challenges in protecting individual privacy and safety. In summary, the technology exists, has been used, and proved valuable in the prevention, diagnosis, treatment, and monitoring of the COVID-19 pandemic, and the pace of implementation innovation needs to be accelerated. The inherent multi-stakeholder value of standardized EHR systems that drive HIE capabilities supports the electronic payment system as the social framework needed for rapid implementation and beneficial use of clinical EHR HIT to its fullest extent in combating the global pandemic.

Factors influencing the uptake of clinical EHRs have been summarized into five categories: intrinsic, non-intrinsic, organizational, recipient, and environmental. The current state of health information exchange and interoperability, facilitated by both clinical EHRs and payment models to incentivize more widespread adoption, remains woefully inadequate across provincial, territorial, and national health populations. The move from volume-based care to value-based care has impacted care through the use of HIT, including establishing strategic alliances with rational partners to maximize the use of technology. Based on the collective insight provided in this section, future directions for HIT research should focus on addressing the deficiencies related to use and uptake, how to reduce deficiencies in supply and demand, increase the efficiency and value for clinical EHRs, and incentivize maximal use of clinical EHRs and HIE to capture the full value of care. The integration potential of HIT capable of meeting the rapidly evolving needs of health care should be used to support

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the COVID-19 pandemic response, drive the advancements of personalized medicine, advance urgent care delivery, and support ongoing care in all settings.

4. Laboratory Services in Public Health Response

Laboratory testing and services are essential to the diagnosis, investigation, and management of public health events. Public health partners and all health care professions must maintain close collaboration in order to optimize the response to community health crises and prevent the overburdening of conventional health care facilities and resources. Communication and information sharing at all collaborative interfaces improve the effectiveness, efficiency, and satisfaction of multidisciplinary work. Expressing and understanding the viewpoints and needs of other professionals involved in community health care enable more readily responsive teams. This team effectiveness report presents insights gained from nursing, medicine, laboratory, radiology, and pharmacy regarding specific aspects of community response to potential health threats. The experiences and recommended solutions described here offer important considerations for enhanced public health collaboration, preparedness, and action beyond the perspective of COVID-19. (Binnicker, 2020)(Health Organization, 2021)

The outbreak of novel coronavirus disease has brought significant abrupt pressure to global and local health care resources and infrastructures. The public health sector in particular faces substantial urgency to expand and deliver health care services to the community. While the importance of workforce collaboration is stated in a diverse array of professional areas, the details of such connections or the degree of their effect might be subtle and/or less readily appreciated. A strong timely response to emerging community health threats not only expands on the needed resources from traditional settings but also relies on strategic collaborations among different service sectors. This study thus seeks to share and draw upon actual experiences and reflections from five public health service sectors to foster public health efforts in the community. Expanding from our team's previous works, our present report emphasizes the role that clinical laboratory services contribute to public health amid an epidemic event from the perspectives of various professions participating in a health care team. Findings and experiences from other health care professionals will provide a broad view of multiple aspects of health menace responses, which can be useful to improve health care collaborations and preparedness in responding to further public health crises.

4.1. Key Functions of Laboratories in Disease Surveillance

Disease surveillance is the ongoing systematic collection, analysis, and interpretation of health data for the purpose of characterizing disease patterns that help monitor changes in disease levels and allow public health programs to plan and conduct effective public health interventions. Classical laboratory functions like testing, confirmatory diagnosis, and disease

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isolation have evolved from a single, isolated, discipline-based activity to a comprehensive and applied activity. Clinical diagnostics are essential for infectious disease detection, investigation, control, and prevention strategies, including outbreaks. The pathophysiology of many infections has gone unexplained because the associated infectious agents were not known or documented. Microbiome studies have described the existence of uncultivated agents in respiratory tracts and highlighted the need for comprehensive studies to elucidate the unclear diversity from a clinical standpoint. Advances in DNA sequencing technology boost the development of pathogen detection which is applied to largely sequence-independent infectious agents and can provide high-resolution, efficient standards for detecting known taxa. Metagenomics has the potential to rapidly identify the cause of infectious diseases; therefore, it is now possible to identify entirely unexpected agents. Although these approaches are advancing rapidly, they have not yet completely obtained the explicit information required to design routine, clinically beneficial diagnostic chemistry, where the correct diagnosis can be made based on the available data. Clinics are certain to benefit from the diagnosis that may transform clinical medicine. Surprisingly, whole genome sequencing has yet to dramatically influence clinical microbiology practice either. Nevertheless, many can foresee a future when clinical laboratories operate as a cross-training entity with intensively collaborating clinical microbiologists possessing the knowledge and ability to interpret patient-specific results.

5. Radiology and Imaging in Public Health

Radiology is a commonly used term for visualizing body parts through a spectrum of invisible direct and indirect artificial energies. To avoid misuse of such artificial energy, a biomedical expert helps in obtaining high-quality data and its visualization, and a biomedical researcher can develop new techniques and new packaging materials for greater benefits to patients. The service of radiology is so inherent in a hospital and health system that it is difficult to select from the day-to-day work experience of this digital diagnostic and prognostic facility, as there is no other service that the radiologic and imaging unit works in isolation. The service's unreported work is usually silently contributing to the prevention of public health diseases, protection of occupational hazards, protection of national wealth, and the safety of many patients. The diagnostic and interventional radiology service helps in saving service users' time, money, and also has the potential of aiding caretakers and decision-makers.

In focusing on public health, branches were called upon to find and allow programs and appeals that relate to public health rather than work for private gains. It was easy to get participation from such a professional radiology and imaging community in programs related to integrating radiology and imaging in public health, as radiology and imaging practice invariably affects public health and quality of living, and indirectly even the radiological

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safety and health of those who work and depend around these units. Participants in these programs include radiological experts who are known to be deeply involved in routine diagnostic and interventional procedures, preventive and occupational health demands of the service users, self and environmental protective precautions, radiation safety regulations, and the possible act of carelessness in providing requested services. The need for this text is to emphasize that these issues have not been solved and that the responsibility and accountability of both the medical association and the members have increased to deliver this aspect of service in society.

5.1. Diagnostic Imaging Modalities in Public Health

Diagnostic and therapeutic medical imaging play a central role in health care delivery. Diagnostic medical imaging has been highly effective in treating diseases and conditions such as cancer, cardiovascular disease, and musculoskeletal conditions. In order to continue to contribute effectively to patient care and to increase the efficiency of health care, increased transparency around the risks and benefits of diagnostic imaging procedures is crucial. Public health professionals can use insights from the diagnostic imaging community to define health risks and benefits in a more balanced way and to identify characteristics of orderers and how clinical settings can be useful surrogate markers for the volume and risk of diagnostic imaging procedures. Quantitative imaging has a highly multifaceted and multidisciplinary context with many actors who contribute to its performance but often view some aspects in relative isolation. The current financial crisis is causing increased scrutiny of the use of health care and has created a need to understand better the impact of diagnostic medical imaging on patient management, patient care processes, and population health outcomes. Radiology plays a foundational role in the clinical management of the patient and the control program because it often emphasizes identifying and characterizing those regions of the body that are responsible for generating symptoms. The use of imaging to monitor emergent and unusual syndromes could document the prevalence and course of these presentations in industrialized and developing economies. The potential role of the imaging service goes beyond these applications to assess issues and potential allocation bias.

6. Pharmacy Services in Public Health Response

The role of pharmacies in public health—especially during emergent events—has become significant. There are teams of licensed pharmacists available 24/7 with access to patient data and direct patient interactions. In the United States, the recommendation for pharmacists' active and collaborative role in immunization services for both medication prescriptions and emergency response has advanced. Collaboration across states to welcome pharmacists' assistance during national emergencies has progressed. Nonetheless, legislation and training to make better use of these professionals to reduce health disparities between various

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population groups could be considered and legislated in the future if such actions have consensus from multiple stakeholders.

The roles of hospitals in public health response during emergent events are well documented. They are actively involved locally. Local clinicians—like medical or pediatric specialists, dentists, nurses, pharmacists, lab scientists, and radiologists—provide patient care, particularly in hospitals during public health crises. Among those local clinicians, only pharmacists provide medications directly to the public at many hours. It has become crucial to mention and explain upgrading and transforming pharmacy practice and pharmacist care delivery, especially since it is acknowledged by other healthcare professionals that engaging and integrating these professionals is ultimately beneficial to improve patients' health outcomes.

6.1. Role of Pharmacists in Public Health Emergency Preparedness

As key players in the health care system, pharmacists have the necessary skills to provide comprehensive patient care services that contribute to the management of public health emergencies. These services are inherently linked to various aspects of public health. By definition, public health is faced with the responsibility of addressing health issues across entire population groups rather than at the individual patient level. A range of knowledge and skills pharmacists should demonstrate in relation to public health emergencies was explored. These roles directly reflect the wider redefined roles of pharmacists.

As the extent of the implications of a major adverse event such as the anthrax attacks exemplifies, it is apparent that many latent public health threats are not susceptible to proactive strategies that can easily be assembled. Despite this fact, pharmacists require an appropriate level of preparedness to provide optimal support during public health emergencies. In order to build capacity to act in new alliances necessary to support public health emergency preparedness, the remodeling of educational curricula is a strategic imperative. Exposure to relevant public health content should be embedded in the undergraduate curriculum and should cover response strategies together with the specific skills needed to address the unique challenges that arise during public health emergencies. In preparing the future multifaceted roles of pharmacy personnel related to public health emergencies, leveraging pharmacy's existing competencies to drive curricular changes is advantageous.

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