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Pharmacists in Pandemics: A Critical Role in Multidisciplinary Healthcare Teams

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Abstract

Pharmacists have demonstrated a critical role during the COVID-19 pandemic, emerging as some of the most relied-upon healthcare professionals (Alves da Costa et al., 2020). As the primary interface between patients and the healthcare system, pharmacists have engaged in a wide array of activities to support the community and other health professionals. A particular emphasis has been placed on their capacity to function as members of a multidisciplinary healthcare team. The continuing COVID-19 pandemic constitutes the greatest public health crisis since the 1918 influenza pandemic. Healthcare systems across the globe have been overwhelmed by the number of patients requiring treatment. Pharmacists have been asked to assume a wide array of responsibilities within the healthcare system, particularly to address the significantly increased demand for medication-related services, often extending even beyond the traditional practice domain. However, the notion of pharmacy practice embracing a multidisciplinary healthcare team (MDHT) model is not unique to any particular global health crisis. Pharmacy's alignment with MDHTs as a general principle of healthcare represents one of the most significant, persistent, and influential facets of the profession over the last several decades. The multidisciplinary approach to healthcare delivery attempts to address the increasingly complex spectrum of patient care by capitalizing on the multiple areas of expertise possessed by diverse healthcare professionals (Ahmed Sami et al., 2021). Collectively, a group of interprofessional healthcare professionals form a team, equipped with an expanded spectrum of skills to deliver an enhanced level of healthcare to the patient, the healthcare system, and the broader community. Conventional MDHTs may be comprised of various combinations of medical practitioners, nurses, and pharmacists, but they are not limited to these healthcare professionals. Other potential healthcare providers that may be included in an MDHT extend beyond the realm of conventional medicine to encompass, for example, paramedics, physiotherapists, or social workers. The inclusion of a pharmacist as a member of an MDHT is seemingly advantageous due to the health professional's extensive knowledge surrounding the domain of medication, which frequently serves as the most prominent and widely utilized mechanism for therapeutic intervention (A. Cadogan & M. Hughes, 2021).The concept of MDHTs, in a general sense, finds further support through an increasing body of evidence that illustrates some of the many benefits associated with healthcare practice governed by teams of healthcare professionals. As a result, the multidisciplinary approach has continued to flourish and grow over the last several decades, being applied across a wide spectrum of different healthcare destinations and settings.

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1. Introduction to Pharmacists in Healthcare

Pharmacists play a crucial role in the complex discipline of healthcare, which demands knowledge from diverse fields and a collaborative approach to meet population needs. Responsible for the preparation and dispensing of drugs prescribed by medical professionals, they offer advice and guidance to ensure the safe and effective use of medication (A. Cadogan & M. Hughes, 2021). The demands placed on healthcare provide an opportunity for pharmacists to prescribe medication themselves and undertake some of the initiatives typically assumed by doctors.

2. The Role of Pharmacists During Pandemics

The role of pharmacists has extended considerably during previous pandemics that include the ongoing COVID-19 crisis, Ebola, and H1N1. As frontline responders and strategic planners, pharmacists are pivotal within multidisciplinary teams, providing essential services and expanding their scope to meet exceptional healthcare demands (Ahmed Sami et al., 2021). Building upon their standard responsibilities in medication expertise and patient care, pharmacists take lead roles in treatment management, infection control, and public education. This crucial integration enhances the effectiveness of collaborative healthcare systems amid the complexity and urgency of a pandemic (K. Thabit et al., 2023).

3. Multidisciplinary Healthcare Teams

Healthcare systems are challenged globally by pandemics such as COVID-19, H1N1 influenza, and Ebola. Multidisciplinary healthcare teams have proven essential for maintaining patient-centred care and ensuring an adequate health-service response (Ahmed Sami et al., 2021). Such teams bring together diverse skill sets and expertise, enabling reliable resource allocation within and across healthcare settings. Pharmacists' participation in multidisciplinary teams is vital given their extensive expertise in medication management, efficient procurement and distribution of medicines, leadership, and support for continuity of care (Alves da Costa et al., 2020). The evolution in pharmacists' responsibilities, jurisdiction, and scope of practice means that none of the major healthcare professions can operate effectively in pandemic circumstances without actively involving pharmacists.

Multidisciplinary healthcare teams combine professionals from diverse fields to meet patients' health needs through differential and complementary skills. They rely on proactive contact, shared objectives, collective decision-making, and exchange of information. The appropriate constellation of diverse professions, disciplines, and organisations for the patient's condition arises from the understanding that no single one can fully meet the patient's needs. Healthcare during pandemics is particularly complex, resource-intensive, and emotionally and cognitively demanding. Coordinated

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work between healthcare workers is essential for dealing with the challenges and uncertainties faced by patients and their carers.

Pharmacists make critical and unique contributions, particularly in relation to pharmacotherapy and the process of medicine-related management. They help frame many health problems and their solutions, offering an extended set of perspectives both within the patient and the wider population. In multidisciplinary terms, they often hold a specialised role that is complementary to others in the system. Pharmacists contribute to developing shared language, knowledge, and solutions.

3.1. Definition and Importance

Multidisciplinary healthcare teams consist of professionals from various specialties working independently or in coordination to deliver comprehensive patient care. Such teams enable the synthesis of diverse expertise, ultimately improving patient health outcomes. In the context of a pandemic, multidisciplinary teams become particularly vital. Their integrated approach addresses the wide-ranging challenges posed by emerging infectious diseases—from controlling infection spread to managing healthcare resources and delivering targeted patient care. Collaboration among diverse healthcare professionals ensures the comprehensive and efficient management necessary to prevent heightened chaos and mortality (Ahmed Sami et al., 2021).

3.2. Composition of Multidisciplinary Teams

Multidisciplinary healthcare teams typically encompass a diverse group of professionals, including physicians, nurses, pharmacists, laboratory scientists, psychologists, and other health workers (Zhao et al., 2021). Although members may differ based on specific healthcare settings, the same six principles of effective teamwork apply across contexts (Alves da Costa et al., 2020). As an integral component, pharmacists bring a distinctive outlook to the planning and execution of pandemic interventions. Tasked with procuring, preparing, and delivering pharmaceutical products, they ensure the availability of essential medications (A. Cadogan & M. Hughes, 2021). Moreover, pharmacists provide essential guidance to both healthcare professionals and patients, enhancing the overall efficacy of pandemic responses. There is growing evidence that multi-professional collaborations, even those involving only two or three participants, can positively influence preparedness outcomes during global health emergencies such as coronavirus disease 2019 (COVID-19).

4. Pharmacists' Responsibilities in a Pandemic

While multidisciplinary healthcare teams are essential for combating pandemics, the responsibilities of individual team members can be difficult to define. Pharmacists offer a broad spectrum of skill and expertise and are therefore capable of fulfilling a wide range of roles and responsibilities during a pandemic.

4.1 Medication management Pharmacists are uniquely qualified to provide medication management services, a critical capability during a pandemic. In addition to their extensive knowledge of the

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physiological, pathophysiological and immunological underpinnings of the human body, pharmacists also possess comprehensive expertise in the manufacturing, compounding, dispensing and distribution of pharmaceutical products. Pharmacists are usually the only healthcare professionals present during the manufacture of pharmaceuticals, and they understand how small modifications in the product or manufacturing process relate to efficacy, adverse reactions and side effects.

In the event of an outbreak, pharmacological interventions are often the only means available to reduce infection rates and to contain the disease. Consequently, a hospital's pharmaceutical stock must rise rapidly. Pharmacists supervise the emergency manufacture and distribution of pharmaceuticals and vaccines to ensure that changes in the drug formulation and distribution process do not compromise safety or quality. When antiviral therapies are used during an outbreak, pharmacists provide additional services to ensure that supplies are maintained, that ease of administration is considered in the intervention design, that drug interactions are minimised, that adverse effects are held to a minimum and that stockpiles of alternative drugs are maintained, and pharmacists devise alternative interventions to contain the disease in the event of resistance (Ahmed Sami et al., 2021).

Pharmacists use this knowledge to ensure the availability of a wide range of pharmaceuticals in retail pharmacies, healthcare facilities or mobile units during an outbreak. Pharmacists dispense vaccines or antiviral medications and define appropriate protocols if an intervention is needed outside the normal licensed approvals.

Pharmacists also provide critical information regarding the correct use of medications. Pharmacists help to design pharmaceutical protocols to ensure the safe application of pharmaceuticals during an outbreak. When the quantity of a particular intervention is limited, pharmacists provide guidance on alternative medications and treatments and suggest strategies to enhance the effectiveness of nonpharmaceutical interventions. Pharmacists also provide healthcare professionals and the general public with accurate, timely information about the supply, administration, side effects and interactions of pharmaceuticals during an outbreak (Alves da Costa et al., 2020). Pharmacists collaborate with manufacturers, hospitals and care initiatives to reallocate or stockpile pharmaceuticals. As the number of interventions typically rises during an outbreak, the allocation of pharmaceutical inventories is exceedingly dynamic and uses pharmacists' expertise to determine case-by-case requirements.

4.2 Patient education and counselling Pharmacists play a vital role in patient education and counselling during a pandemic. Healthcare professionals may find themselves over-committed during an outbreak, with many patients seeing their family physician or hospital only when symptoms have escalated significantly (A. Cadogan & M. Hughes, 2021). In such situations, community pharmacists are often the most accessible healthcare practitioners, and they provide essential advice to the public.

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Pharmacists often serve as the primary source of learning for prevention. Pharmacists offer advice concerning epidemiology and hand hygiene and provide direct clarification to allay fears or misunderstandings about infectious diseases.

Pharmacists must remain alert for possible symptoms through verbal and nonverbal channels, and they steer patients toward additional help or prevent the transmission of infection by restricting access to the public. Pharmacists play a similar role for chronic or mental health patients, offering continued care and support. During an epidemic, pharmacies are among the only public locations that remain open. Consequently, pharmacists provide support—critically needed in the context of stress and social isolation—to patients with chronic and mental health conditions who are unable to access the usual multiple sources of support.

4.1. Medication Management

Pharmacists play a vital role in multidisciplinary healthcare teams managing medication during pandemics. They oversee drug therapy and supply, supporting rational, safe, and effective use. Managing the quantity and availability of medications and medical devices is critical, requiring monitoring and control of the supply chain, especially when high demand, panic buying, and stockpiling disrupt distribution and stocking procedures (Ahmed et al., 2022). Constraints on supply create pressure on healthcare services. Rotating older stock to the top of shelves, monitoring expiry dates, and coordinating supply between hospitals and community pharmacies is essential. Pharmacists evaluate clinical parameters to obtain and follow the best treatment strategies, decrease overcrowding at medical centers, and reduce pressure on primary care, GP surgeries, hospitals, and emergency departments.

Pharmacists have been involved in planning medication strategies to ensure appropriate medicines, equipment, and services are available to support patient care (A. Cadogan & M. Hughes, 2021). With demands on hospitals and GP practices, managing repeat prescriptions challenged emergency supply legislation, prompting measures allowing pharmacists to dispense further supplies of recent prescriptions. Emergency supply provisions enable pharmacists to ensure continuity of medication supply when patients cannot obtain prescriptions. Emergency supply requests, particularly for older patients and those with long-term conditions, help divert patients from emergency care services. Shortages arising from ordering, manufacturing, or distribution problems create safety risks, increase rates of medication errors, and produce adverse clinical and humanistic outcomes. Guidelines provide frameworks to manage shortages, but no approach completely eliminates risks. Pharmacists mitigate shortages, reassure the public on availability, and implement policies to prevent stockpiling.

4.2. Patient Education and Counseling

Patient education and counseling constitute pivotal responsibilities for pharmacists during pandemics (A. Cadogan & M. Hughes, 2021). Patients must maintain adherence to their prescribed medication regimens to prevent deteriorations in health status that would place further demands on health

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services. Studies involving patients with chronic conditions affected by Hurricane Katrina reported that one fifth of participants reduced or stopped their medication due to limited access to healthcare, medications, and financial issues. Employment and access to healthcare services, especially during social distancing and self-isolation requirements, create new barriers to medication adherence. Innovative service-delivery methods such as medication delivery and video consultations are therefore increasingly necessary. Additionally, patients require information on preventive measures and the proper use of masks, hygiene, and physical distancing. The medical community can rely on pharmacists for education and counseling regarding symptom identification, tips to improve the immune system, recommendations for over-the-counter products, and the correct application of other healthcare protocols (Silva-Suárez et al., 2022).

Moreover, community pharmacists serve as a prominent source of education and advice during pandemics. They frequently interact with patients and are, in consequence, ideally placed to contribute to pandemic management. They can provide advice both directly to those who present themselves and via migration from less accessible locations to more heavily populated regions. Relocation may require adaptation to specific pandemic conditions and may include the establishment of new community pharmacies or distribution channels.

4.3. Collaboration with Other Healthcare Professionals

Within the framework of multidisciplinary teams, pharmacists are tasked with supporting and collaborating with healthcare professionals to address evolving healthcare needs during a pandemic. Collaboration enhances the efficacy of healthcare systems in responding to such crises (Ahmed Sami et al., 2021).

Pharmacists maintain frequent communication with prescribers to clarify medication orders, provide recommendations on therapeutic alternatives, address drug interactions and adverse reactions, and ensure the continuity of treatment. They also assist in transitioning patients between care settings and participate in the discharge planning process and monitoring of therapies (Aruru et al., 2020). These activities typically take place through multidisciplinary rounds, patient transfers, and discharge procedures, often involving direct interaction with patients, who may be in isolation. As the frontline healthcare professionals who most often interact with patients, pharmacists have the opportunity to educate and promote truthful information, thereby combating the dissemination of rumors and misinformation.

5. Case Studies of Pharmacists in Action

Several case studies focus on the role of pharmacists in pandemic responses, illustrating essential duties such as medication management, patient counseling, and inter-professional collaboration (Alves da Costa et al., 2020). During the COVID-19 pandemic, pharmacists assumed frontline responsibilities within various healthcare contexts (e.g., hospital wards, community settings, intensive care units). They adapted their practices and implemented innovative solutions to maintain

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clinical services, often serving as patients' first point of contact when general practitioner access was limited. Motivated by professionalism and humanistic goals, pharmacists participated in infection control strategies alongside other healthcare personnel, provided educational materials and verbal counseling to counter misinformation propagated through social media, and rapidly developed new clinical skills to care for ICU patients. Previous case studies from the Ebola and H1N1 influenza pandemics similarly highlight pharmacists' cross-pandemic contributions to public health management and multidisciplinary care coordination.

Saudi Arabia's first case of Middle East respiratory syndrome coronavirus (MERS-CoV) emerged in September 2012. In response, the Saudi Ministry of Health implemented extensive quarantine measures, screening approximately 5,000 pilgrims. Pharmacists collaborated with healthcare teams to provide both general and pandemic-specific training, supply essential medications and diagnostic kits, manage side effects, and educate quarantined individuals.

During the H1N1 influenza emergency of 2009–2010, pharmacists expanded beyond traditional roles to contribute to both routine and non-traditional healthcare capacities. They maintained medication continuity, administered vaccinations, reinforced infection control measures, dispensed appropriate medications, and provided educational content for at-risk populations.

5.1. COVID-19 Response

Before the COVID-19 pandemic was officially announced, the Chinese Government had adopted containment strategies and policies to reduce the risk of transmission. Pharmacies and pharmacists were considered to be the first of a chain of support. Frontline pharmacists assisted the public by managing large demands for over-the-counter products, supply chain and inventory management, medication advice and referral, cold and flu prevention advice, the development of new guidelines, and home delivery services (Alves da Costa et al., 2020). Frontline hospital pharmacists contributed by managing off-label COVID-19 therapies, patient counselling and discharge medication planning. Matched with the volume of prescriptions and OTC supply from general practitioners, non-pharmacist staff were tasked with initial screening and the recording of simple temperature readings to limit the spread of disease. As demand grew, more complex triaging shifted to pharmacy staff (Paudyal et al., 2020). Once declared a pandemic, pharmacists globally demonstrated a commitment to protecting public health, with an extension of their roles, expertise, and competences. Pharmacies and pharmacist boards were quick to respond by issuing new guidance and providing pandemic-specific recommendations to assist with the changes. The services provided in some countries included influenza vaccinations, support and information around the increase in domestic violence, PPE supply, home delivery of medications and other goods, management of drug shortages through therapeutic substitution, and triaging of prescriptions and OTC medicines across early stages of the pandemic. Handling inpatients was restricted to only essential clinical interactions, such as anticoagulation monitoring or discharge counseling, with most over-the-counter recommendations and advice shifted to community pharmacies. Pharmacists also worked alongside politicians, supply

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chain specialists, key workers, and other healthcare professionals to overcome operational and regulatory barriers to continue to dispense essential medicines and provide effective pharmaceutical care throughout the pandemic.

5.2. Ebola Outbreak

The Ebola virus disease outbreak, which began in Guinea in December 2013 and subsequently spread to Liberia, Sierra Leone, and other West African countries, has had one of the greatest social and economic consequences among the African population. The numerous gaps in epidemiology and infectious diseases posed severe challenges in pandemic control and risk for epidemic preparedness. In addition, the sparse knowledge of healthcare professionals and the general public combined with a lesser response from the International community were major factors for the dissemination of the disease. A critical role has been played by local pharmacists in surveillance, drug supply, infection control measures, clinical trial protocols and patient care, highlighting their fundamental role in the multidisciplinary healthcare team (Bai James et al., 2016).

5.3. H1N1 Influenza

The H1N1 influenza pandemic constitutes a relevant case study for pharmacists' contributions within multidisciplinary healthcare teams responding to global health crises. Pharmacies continued to provide essential primary-care services, including influenza testing and treatment, throughout the surge. Pharmacists' supply-chain expertise contributed to efforts for managing nationwide drug shortages generated by increased antiviral demand and patient-stockpiling behaviours. Nationwide telephone surveys conducted during April and July 2009 revealed a surge in antibiotic prescriptions issued by primary-care physicians, providing secondary disease-prevention opportunities for pharmacy services. Emergency-supply systems were triggered to maintain uninterrupted medication access for quarantined or socially distant patients. Community pharmacists strengthened collaborative roles with colleagues in general practices and hospitals, alleviating patient-flow pressures (A. Cadogan & M. Hughes, 2021). Interprofessional collaboration remained indispensable across the multi-phased crisis, underpinning pharmacists' capacity to implement innovative services and adapt established ones.

6. Challenges Faced by Pharmacists

Pharmacists play a critical role in multidisciplinary healthcare teams during pandemics. Their responsibilities include medication management, patient education, and collaboration with other healthcare professionals. However, pharmacists face several challenges during a public health crisis. First, supply chain issues arise as increased demand for medicines and personal protective equipment stretches existing resources (A. Cadogan & M. Hughes, 2021). Maintaining adequate stock to meet patient needs becomes an ongoing concern. Second, information overload complicates dissemination of the latest guidelines. Pharmacists must navigate rapidly changing recommendations from local and international authorities to provide accurate counsel (Ahmed Sami et al., 2021). Finally,

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communicating public health information while managing patient fears can be difficult. Aggressive behaviour among stressed patients interferes with pharmacists' ability to offer support and educate effectively. Pharmacists also experience ethical dilemmas when prioritizing patient care in the face of limited resources.

Despite these obstacles, pharmacists worldwide continually adapt in response to new challenges. They serve at the forefront of worldwide vaccination campaigns and assist with chronic disease management under changing restrictions. Professional associations and governments recognize the pivotal position of pharmacists within healthcare, underscoring the need to address existing challenges (Alves da Costa et al., 2020). Preparing the workforce for future crises requires strategic action to offset barriers to practice and maximise the contribution of pharmacists during pandemics.

6.1. Supply Chain Issues

Pharmacists are responsible for ensuring the availability of medicines and medical devices during a pandemic. Implementing measures to enable pharmacists to dispense additional supplies of repeat prescriptions at appropriate intervals helps maintain continuity of medication when patients cannot obtain prescriptions from prescribers. Exceptionally, emergency supply provisions empower community pharmacists to exercise professional judgment in providing continuous medication. Such requests are common, especially out of hours, among older patients and those with long-term conditions, and pharmacists are well placed to handle them, thereby diverting patients from emergency care services. The quantity supplied in these circumstances is limited to a maximum when a full prescription is not presented. Stockpiling medications can disrupt the medication supply chain, leading to shortages when supply is insufficient to meet demand due to ordering, manufacturing, or distribution issues. Clinical consequences include an increased risk of medication errors and adverse patient outcomes. Additionally, shortages place considerable strain on pharmacy resources, necessitating the sourcing or substitution of therapeutics and liaison with clinicians to determine suitable alternatives. The complexity of managing shortages precludes a single approach capable of eliminating the risk to patients. Pharmacists play a key role in reassuring the public about the continued availability of medicines and in preventing unnecessary stockpiling during a public health emergency (A. Cadogan & M. Hughes, 2021).

6.2. Information Overload

Alongside other health crises such as infectious disease outbreaks and natural disasters, pandemic situations have motivated the employment of social media to help track the spread of the disease, disseminate information to the public and find much needed support (Ahmed Sami et al., 2021). This in turn has generated an overload of information from a variety of sources that is difficult to handle, often referred to as infodemic. While it can provide useful up-to-date information, it can also disseminate inaccurate content that can generate a widespread of misinformation across society. The

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national healthcare systems can be severely affected by this infodemic and require a multidisciplinary team to deal with it (A. Cadogan & M. Hughes, 2021).

6.3. Public Health Communication

Pharmacists play a vital role in public health communication efforts during health emergencies, providing guidance and instruction on disease prevention and medication use (Aruru et al., 2020). Community pharmacists are often among the first professionals to clinically assess potential cases in a pandemic (A. Cadogan & M. Hughes, 2021). Due to their high accessibility and ease of contact, pharmacists can address misinformation and provide reassurance to the public relating to public health matters (Muflih et al., 2021).

7. Training and Preparedness of Pharmacists

To ensure normal operations of pharmaceutical systems during a pandemic, pharmacists must be trained for such situations. Through training programs and simulation exercises, pharmacists can gain experience in a safe setting to enhance their ability to respond effectively to pandemics. Appropriate training increases the number of healthcare professionals available for deployment and improves communication and collaboration between different responders and agencies. Moreover, management training equips pharmacists to perform well in operational situations. Such readiness enables pharmaceutical personnel to handle the mental and emotional stresses of emergencies and to optimize patient care in various roles during the outbreak.

7.1. Educational Programs

Educational programs and simulation exercises should prepare pharmacists for pandemics, enhancing their capabilities to fulfill critical relief functions in multidisciplinary teams. Incorporating emergency preparedness and response into pharmacy education is essential to equip pharmacists with the necessary knowledge, willingness, and readiness to assist effectively during crises (Zhao et al., 2021). Training strategies include curriculum integration, continuing professional development, interprofessional education, and compliance with accreditation standards (Aruru et al., 2020). Such preparation enables pharmacists to address practical challenges, manage the intricate medication supply chain, provide comprehensive counseling, and maintain seamless communication with other healthcare professionals throughout a pandemic.

7.2. Simulation Exercises

As emergency preparedness plans are often designed in a very short time, drills are essential for training healthcare professionals in a practical way and for identifying vulnerabilities. Simulation is a key method for healthcare teams, including pharmacists, reinforcing their role in multidisciplinary pandemic responses (Schumacher et al., 2022). Several types of simulation exercises exist: tabletop exercises, full-scale field exercises, simulators, augmented reality, and functional real-time exercises.

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Drills may focus on particular professionals, patients, or entire systems, with individual and team training representing key objectives.

Full-scale simulation is defined as a high-fidelity interactive disaster situation oriented toward replicating reality. It is commonly used by police, firefighters, and logistics organizations; however, studies evaluating its utility for training hospital pharmacies in major incidents or disasters are lacking. According to the World Health Organization, exercises involving a drill or simulation should be regularly conducted within hospitals and healthcare systems, and the French National Health Authority recommends three distinct phases: briefing, planning and preparation; a field day for exercise execution; and a debriefing phase. The efficacy of full-scale simulation as a training tool for improving the disaster preparedness of hospital pharmacies remains an area of investigation.

8. Technological Innovations Supporting Pharmacists

Pharmacists play multiple key roles during pandemics. They participate in medication management by selecting, procuring, and distributing COVID-19 therapeutic agents (Ahmed et al., 2022). As educators and counselors, pharmacists address patients' medication- and disease-related concerns (A. Cadogan & M. Hughes, 2021). Working alongside interdisciplinary colleagues, pharmacists raise healthcare professionals' awareness of new COVID-19 therapies and contribute to the design of infection control protocols. Special healthcare teams that include pharmacists also perform tasks related to the anticipated rise in chronic disease cases, resulting from COVID-19 both directly and through the adverse consequences of lockdowns. Inside hospitals, pharmacists develop guidance for the safe use of COVID-19 vaccines. They engage in vaccine administration through community pharmacies, which often remain operational to ensure patients' access to essential medicines and services during periods of lockdown. The pandemic enhances opportunities for inter-professional collaboration, especially when establishing nationwide vaccination initiatives.

Telepharmacy provides pharmaceutical services when direct interactions with patients is impossible. It also facilitates the constant availability of professional pharmaceutical advice for healthcare professionals, the general public, and patients with COVID-19 who self-isolate or are discharged. Data analytics empowers professionals to improve decision-making throughout the supply chain, by accurately forecasting medication requirements and promptly identifying impending shortages (A. M. Gregory & Austin, 2020).

8.1. Telepharmacy

Telepharmacy represents a significant advancement in pharmaceutical care and is strategically prioritized for pharmacy practices. Telepharmacy services ensure continued access to essential medications, remote evaluation of drug prescriptions and patient care, and facilitate professional communications among healthcare providers at different sites.

The COVID-19 pandemic has highlighted the critical role of community pharmacists in strengthening primary care and public health responses, driving new developments in public policies

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for health emergencies. Pharmacists practice globally in primary and secondary care environments, and their participation in emergency preparedness programs is not universal. Technological advancements provide expansive opportunities for the pharmaceutical profession and patient care.

Recent experience during the COVID-19 lockdown underscores the importance of the telehealth sector in enabling offers and developing new pharmaceutical services that guarantee access to community pharmacies. These modalities also address ongoing patient needs and ensure the safety of professionals and people with chronic conditions. Telehealth is well-suited to these objectives but requires reflection on its operation and areas for improvement, emphasizing safety and ethical use (Ferrera Bibas et al., 2021).

8.2. Data Analytics in Pharmacy

Data analytics and modelling play a significant role in understanding health-related disasters and supporting preparedness and strategic planning (K. Thabit et al., 2023). Analytics enable the development of automated tools that assist healthcare policy makers in responding effectively to contingencies. At the peak of the COVID-19 pandemic in July 2020, South Korea adopted a data-driven approach to allocate medical resources, focusing on managing critical cases and addressing disparities in Severe Acute Respiratory Infection (SARI) treatment across regions.

9. Policy and Advocacy for Pharmacists

The COVID-19 pandemic has intensified interest in the roles of pharmaceutical and healthcare professionals (Aruru et al., 2020). Pharmacists have continued to play crucial roles in pandemics with increased importance in responding to the emergency health crisis (A. Cadogan & M. Hughes, 2021).

Following the devastation caused by the COVID-19 pandemic, the first community pharmacist was given the privilege to administer a vaccine by the United States Department of Health and Human Services. Pharmacists, working alongside colleagues from other disciplines, have been directly involved in delivering healthcare during the crisis. Legislative changes have facilitated the provision of pharmacy services to patients, either remotely or in person. By partnering with health and public agencies, pharmaceutical agencies and societies continue to monitor the outbreak and to provide the necessary information.

9.1. Legislative Changes

A key observation from the COVID-19 pandemic is that states and provinces with provisions allowing pharmacists to practice at the top of their licensure during a public health emergency were able to deploy a fully engaged and effective workforce to address critical needs. Several regions expanded pharmacists' prescribing authorities, permitted pharmacists and pharmacy technicians to perform COVID-19 testing, waived substitution restrictions, and increased the allowable days' supply of some medications (Aruru et al., 2020). These changes, among others, facilitated full

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pharmaceutical services and support to overwhelmed healthcare providers and institutions. Some temporary expansions have been made permanent, such as Idaho elevating pharmacists' status to recognized providers for Medicaid reimbursement, and increasing quantities for pharmacy-dispensed naloxone. Even jurisdictions without pre-existing emergency scope-of-practice legislation experienced streamlined processes for similar expansions (Merks et al., 2021).

It appears inevitable that some degree of expanded professional autonomy will be retained permanently, as further restrictions would likely hinder pharmacists' integration into healthcare systems. Pharmaceutical organizations will advocate for permanent adoption as legislation and opportunities for expansion of scope continue to be discussed (A. Cadogan & M. Hughes, 2021). Legislative measures developed in response to a public health emergency should be broadly adaptable to meet a wide spectrum of future needs. PRN personnel and pharmaceutical expertise that can be rapidly activated will be crucial in combatting any additional waves, novel variants, or entirely new organisms, with legislative frameworks providing much of the necessary structure.

9.2. Professional Organizations' Role

Professional organizations play a pivotal role in delineating the essential functions that pharmacists are expected to fulfill during and after pandemics, thereby influencing the design and execution of pertinent educational and training programs. In the context of the COVID-19 pandemic, professional bodies have not only outlined pharmacists' responsibilities but have also advocated for the removal of legal and regulatory impediments, thereby establishing a foundation for pharmacists' collaboration with other healthcare professionals within multidisciplinary teams (Aruru et al., 2020). The critical importance of inter-professional and intra-professional collaboration in mitigating disparities and enhancing the efficacy of healthcare services, particularly during crises such as the COVID-19 pandemic, has been underscored by several organizations. These entities have documented specific instances where pharmacists, working in concert with physicians, nurses, and other healthcare staff, have made substantial contributions to clinical decision-making, medication management, patient care, public education, and the development of infection control guidelines (Ahmed Sami et al., 2021). The collective impact of these collaborations extends across diverse settings, including community pharmacies, hospitals, correctional facilities, industrial pharmaceutical companies, and clinical trial operations, thereby affirming the integral role of pharmacists in the multidisciplinary response to pandemic challenges.

10. Future Directions for Pharmacists in Healthcare

Growing collaboration with multiprofessional teams beyond pharmacists, physicians, and nurses could impart extensive medical care, offering significant benefits in future pandemics or other medical catastrophes. Pharmacists could assume leadership roles in multidisciplinary services, akin to those during the extensive Ebola outbreak from 2014 to 2016. Additionally, they may support

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health systems through community empowerment by dedicatedly managing pharmaceuticals in pandemics, with a focus on infection prevention and public communication.

Further reflection and advancement in pharmacy services during pandemics are essential, with the analysis of COVID-19 and comparable scenarios forming a foundation for scientific improvements. Scholars have identified six pivotal points at regional and national levels for advancement: workforce development addressing employment conditions and burnout; inter-and intra-professional collaboration fostering teamwork and collaboration; remuneration and funding underpinned by innovative methods and recognition of contributions; effective communication integrating technological capabilities; leveraging technology through telepharmacy and artificial intelligence; and enhancing research and evidence-based approaches focusing on mental health and personalized care (Ahmed et al., 2022). Future research should undertake rigorous investigations centred on community pharmacists—often the most readily accessible healthcare providers—exploring services such as telehealth, home delivery, psychological support, prescribing, treatment guidance, and cost-effectiveness. Evaluations of long-term outcomes for COVID-19 patients, including quality of life and mortality, also remain priorities.

10.1. Emerging Roles

Pharmacy is an integral part of healthcare, and pharmaceutical care through patients' medication is the cornerstone of this profession. Through its fundamental role in providing reliable and evidence-based information about various drugs and clinical conditions, it has broadened its impact on the healthcare service (Alves da Costa et al., 2020). The healthcare sector is emerging as one of the largest sectors globally, and the field needs to be continuously reformed to manage the growing population, epidemics, and pandemics. Pharmacists are a critical part of the healthcare professions and play a core role in the medication management process of healthcare (A. Cadogan & M. Hughes, 2021). As the risks for medicine shortages and supply chain interruptions increase during any health crisis, the pharmacist's role within the health service system becomes more prominent to the general population and the health management organisation.

A pandemic occurs when an outbreak of a disease/scenario becomes so widespread that it affects an exceptionally high number of people with the potential of severe mortality and economic disruption. The global pandemic COVID-19 is an exemplary example of the conditions of a pandemic that can affect the whole world and result in the death of millions of people. A global pandemic requires coordinated, collaborative, adaptable, and flexible actions between international, regional, and local administrations and authorities (Ahmed et al., 2022). A similar analogy applies to the healthcare industry, in which a pandemic requires a multidisciplinary healthcare team to coordinate and combat the challenges and evolving changes of the healthcare sector and provide the best healthcare service.

A multidisciplinary healthcare team (MDHT) is defined as a variety of healthcare professionals working together to deliver the best possible healthcare service. Similarly to the governance

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structure, it is a multidimensional, diverse, and multilayered approach to healthcare delivery that includes a variety of specialisations and implications. With the need for specialised knowledge about medicines and the legislative and ethical perspectives of dispensing medicines, the pharmacist holds the key role of being one of the main members of a successful MDHT and the only professional with extensive knowledge of medicines and global medicine-related topics. The healthcare system also has a critical role in maintaining life and the sustainability of society. Due to its importance to life and its association with human life, there are overlapping dimensions with it, such as politics, ethics, philosophy, and faith. These dimensions contribute to the composition of the team and the roles and responsibilities of any member.

10.2. Research Opportunities

Linking healthcare workers, the pharmaceutical industry, the public, and practice researchers in global disease surveillance and early warning; expanding training and research capacity and infrastructural support for pharmaceutical practice development in infection control; and monitoring and evaluating the impact of pharmacist interventions that are effective in other urgent public health situations (e.g., antimicrobial stewardship). The emerging infectious diseases agenda is closely related to that for pandemics and emergency preparedness.

11. Conclusion

The COVID-19 crisis has magnified the role of pharmacists in healthcare teams. Pharmacists working alongside other health professionals have been an indispensable component of the pandemic response. Operating in multidisciplinary teams of physicians, nurses, allied health professionals, pharmacists, and support workers, when pharmacists embrace responsibilities such as medication management, patient education, counseling, and collaboration, teams are best equipped to confront pandemics convincingly. Successful strategies developed during the pandemic offer useful models for policymakers in both practice and education. As analysis of the literature reveals, adapting national frameworks will strengthen efforts to contain future outbreaks (Ahmed Sami et al., 2021).

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