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Global contributions of pharmacists during the COVID-19 pandemic

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Abstract

Throughout the SARS-CoV-2 (COVID-19) global pandemic, pharmacists were rarely mentioned as essential frontline health care providers by the news media, the public, or politicians. Around the world, pharmacists are working on the frontlines of health care every day providing essential health care services during the pandemic. Pharmacists are medication experts providing patient care in a variety of settings including hospitals, clinics, community pharmacies, long-term care, physician offices, and national and public health. In this paper, we describe how pharmacists from high and low-middle income countries contributed to essential patient care and well-being of the public during the COVID-19 pandemic. While the news media, the public, and politicians often overlooked pharmacists as essential frontline health care providers,

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we hope that this list of contributions by pharmacists from nine countries in this article can help to change this perspective.

KEYWORDS

antibiotic stewardship, coronavirus, global health, pandemic, pharmacists, pharmacy

1 | INTRODUCTION

While the SARS-CoV-2 (COVID-19) pandemic spread across the world, the World Health Organization (WHO), the news media, and others recognized physicians and nurses for their heroic frontline efforts. Pharmacists, however, were rarely mentioned. Around the world, pharmacists are working on the frontlines of health care every day providing essential health care services throughout the pandemic. Pharmacists are medication experts providing patient care in a variety of settings including hospitals, clinics, community pharmacies, long-term care, physician offices, and national and public health. Pharmacists are among the most accessible health care professionals, with 90% of Americans living within 5 miles of a community pharmacy.[1] As challenges from the COVID-19 pandemic mount, pharmacists are answering the call to action but are the public, the news media, or politicians aware of the contributions by pharmacists?

In a recent editorial titled "*Hero Clinical Pharmacists and the COVID -19 Pandemic: Overworked and Overlooked*", Bauman states that in U.S. academic health centers, other health care providers acknowledge and champion pharmacists as valued team members; however, "this knowledge has not always been translated to the public, the news media, and politicians".[2] Cheong and colleagues published a pharmacist's "call to action" to commit to public action now to raise the bar for the public's expectations of how pharmacists contribute to the quality use of medications during the pandemic and chronic situations.[3] Pharmacy societies and organizations have provided numerous COVID-19 educational resources. (Table 1) To date, pharmacists from China, Australia, Malaysia, Saudi Arabia, and the United States (US) have described a variety of roles and contributions from pharmacists during the COVID-19 pandemic.[3-10]

Hospital pharmacists are evaluating emerging COVID-19 drug therapy options to rapidly make patient care decisions, monitoring and adjusting COVID-19 medications to prevent adverse side effects, managing numerous drug shortages, maintaining uninterrupted drug supply, resolving supply chain issues for critical care medicines, adjusting workflow to preserve personal protective equipment, and establishing new pharmacy services in temporary emergency COVID-19 hospitals. Experience from one U.S. hospital identified that COVID-19 patients received an average of 19.8 different medications and pharmacists made an average of eight interventions per patient.[6] A panel of U.S. physicians and six clinical pharmacists co-authored the National Institute of Health (NIH) treatment guidelines for COVID-19 intended for frontline health care providers caring for patients during the rapidly evolving pandemic.[11]

Community pharmacists are setting up COVID-19 clinics, using telehealth to provide chronic care management, and providing COVID-19 testing and guidance once results are known. Pharmacists are also applying their extensive knowledge and training in medication use, management, and problem-solving to provide COVID-19 public health education to the public. The purpose of this article is to describe how pharmacists from selected high- and low-middle income countries contributed to essential patient care and the well-being of the public during the COVID-19 pandemic. Pharmacists from nine countries were selected based on previous antibiotic stewardship work with the senior author (DG) of this paper. She has worked globally with pharmacists across six continents and maintains interactions with this network of pharmacists through collaborations in research, publications, and use of social media. Figure 1 is a map of the world highlighting examples of pharmacist's contributions from these nine countries during the COVID-19 pandemic.

2 | THE UNITED STATES

2.1 | The Ohio State University Wexner Medical Center, Columbus, Ohio

Pharmacists at The Ohio State University Wexner Medical Center (OSUWMC) in Columbus, Ohio worked with hospital senior leadership and the disaster preparedness team to identify and execute essential pharmacy services for COVID-19 inpatients and outpatients. Over 450 pharmacists, pharmacy technicians, residents, and student interns provided adapted traditional and novel essential COVID-19 pharmacy services.[8,12] Additional new pharmacy services were identified as the pandemic evolved. For example, as our city prepared for a surge of COVID-19 patients, an entire pharmacy was set up in the convention center that was serving as a COVID-19 overflow hospital. An emergency medicine pharmacist was deployed to New York City to assist during their surge of COVID-19 patients. Pharmacists established a new ambulatory care COVID-19 clinic to assist in the management of COVID-19 patients post hospital discharge. The OSUWMC public relations (PR) team collaborated with a senior infectious diseases (ID) pharmacist and author of this paper (DG) to provide COVID-19 education to the public and Ohio State University employees. To date, the PR team arranged over 20 interviews with the ID pharmacist and local television health reporters, national news media, magazines, and the OSUWMC health blog. The OSUWMC social media team and the ID pharmacist used Twitter as a tool to provide accurate and factual COVID-19 information to the public. The ID pharmacist (@idpharmd)

TABLE 1 Examples of pharmacy societies and pharmacy organizations contributions during COVID-19 pandemic

Country	Organization/society	Description	Link
United States	IDStewardship	Provides comprehensive general, Institutional, Governmental & Society COVID-19 Treatment Guidelines and resources for pharmacists.	https://www.idstewardship.com/coronavirus-covid-19-resources-pharmacists/
	Society of Infectious Diseases Pharmacists (SIDP)	Evidence-based reviews and podcasts of potential pharmacotherapeutic treatment options for COVID-19	https://www.sidp.org/covid19
	American Society of Health Systems Pharmacists (ASHP)	Support for all healthcare providers to enhance the safe use of medications, deliver quality care, and enhance patient outcomes.	https://www.ashp.org/COVID-19?loginreturnUrl=SSOCheckOnly
	American College of Clinical Pharmacists (ACCP)	Features short stories documenting pharmacists COVID-related practice, research, education, or leadership	https://www.accp.com/membership/clinicalPharmacyInAction/covid19.aspx
International	International Pharmaceutical Federation (FIP)	COVID-19 information hub with international guidelines	https://www.fip.org/coronavirus
International	Commonwealth Pharmacists Association	COVID-19 Continuing Professional Development resources hub for commonwealth countries COVID-19 app	https://commonwealthpharmacy.org/what-we-do/covid-19-resources-2/
United Kingdom	Royal Pharmaceutical Society	Policy asks and advocacy, national guidance for pharmacy professionals, posters and campaign materials, clinical resource hub Training webinar series in collaboration with expert groups across the profession Training resources to upskill redeployed pharmacists	https://www.rpharms.com/coronavirus
	United Kingdom Clinical Pharmacists Association	Training webinars in collaboration with Royal Pharmaceutical Society and relevant resources for clinical pharmacists	https://ukclinicalpharmacy.org/featured/covid-19-literature-update/
	Specialist Pharmacy Services	National COVID-19 resources and *medicines* guidance summaries	https://www.sps.nhs.uk/category/covid-19-coronavirus/
	National Pharmacy Association	COVID-19 Resources for community pharmacy	https://www.npa.co.uk/coronavirus-updates/
	General Pharmaceutical Council	Examples of notable practice in community pharmacies during COVID-19 pandemic	https://inspections.pharmacyregulation.org/Knowledge-hub
Australia	Society of Hospital Pharmacists Australia (SHPA)	COVID-19 information hub with resources for pharmacy departments, continuing professional development offerings and a discussion forum for sharing of information and questions	https://www.shpa.org.au/covid-19
	Pharmaceutical Society of Australia (PSA)	COVID-19 information hub with regulatory updates, resources, links and information for patients and the community	https://www.psa.org.au/coronavirus/
Canada	Canadian Society of Hospital Pharmacists (CSHP)	Features a pharmacy specialty network, educational videos, and links to COVID-19 resources for pharmacists in hospitals and other collaborative care settings	https://cshp.ca/covid-19
	Canadian Pharmacists Association (CPhA)	Pharmacist advocacy, practice resources, drug therapy information, posters as	https://www.pharmacists.ca/advocacy/covid-19-information-for-pharmacists/

TABLE 1 (Continued)

Country	Organization/society	Description	Link
		well as graphics and videos for social media	
Saudi Arabia	Saudi Society of Clinical Pharmacy (SSCP)	Pharmacists roles and responsibilities during epidemics and pandemics in Saudi Arabia: An opinion paper from the Saudi Society of clinical pharmacy	https://doi.org/10.1016/j.jsps.2020.07.002
	Saudi Pharmaceutical Society (SPS)	A report on COVID-19 and its management	https://www.docdroid.net/IEIN7Of/coronavirus-sps-pdf
	Saudi Oncology Pharmacy Assembly (SOPA)	Practical strategies to manage cancer patients during the COVID-19 pandemic: Saudi Oncology Pharmacy Assembly Experts recommendations	https://journals.sagepub.com/doi/full/10.1177/1078155220935564
South Africa	South African Society of Clinical Pharmacy (SASOCP)	A practice guide for clinical pharmacists featuring the role of the clinical pharmacist in COVID-19	https://www.sasocp.co.za/
	Pharmaceutical Society of South Africa (PSSA)	COVID-19 webinar series and guideline for community pharmacists. Policy tasks and advocacy, assisting and supporting pharmacists in business and other legislative matters	https://www.pssa.org.za/
Nigeria	Pharmaceutical Society of Nigeria (PSN)	A practice guideline for front-line pharmacists. Lobbied government to provide grants for local production of medicines.	https://psnnational.org/index.php/2020/05/07/press-release-psn-commends-fgn-on-import-waiver-for-pharmaceuticals-medical-supplies/
	Association of Community Pharmacists in Nigeria (ACPN)	National awareness campaign on personal hygiene and drug misuse during the azithromycin hydroxychloroquine controversy. Community pharmacies dispense rapid diagnostic test kits and discounted sanitizers	http://acpnigeria.org.ng/
	Nigerian Association in Industrial Pharmacists (NAIP)	National production of Covid-19 and essential medicines to mitigate shortages	https://www.von.gov.ng/covid-19-stakeholders-collaborate-to-boost-pharmaceutical-manufacturing-in-nigeria/
	Association of Hospital and Administrative Pharmacists of Nigeria (AHAPN)	Part of the front line team in COVID-19 isolation and treatment centers, involved in medication review, dispensing and monitoring.	https://ahapnnational.org/ https://healthwise.punchng.com/six-frontline-pharmacists-test-positive-for-covid-19/
	Clinical Pharmacy Association of Nigeria (CPAN)	COVID-19 webinars and its effect on daily work life.	https://www.facebook.com/Clinical-Pharmacists-Association-of-Nigeria-FB-Page-106584164069990/

and OSUWMC (@OSUWexMed) extended the reach of their COVID-19 tweets by retweeting tweets to their 7900 and 26 000 followers, respectively. For example, two articles by @idpharmd titled "*How to Clean Your Cellphone*" and "*Do Plastic Face Shields Actually Do Anything?*" had 880 and 1076 Twitter engagements and impressions were 22 458 and 15 986, respectively. The Centers for Disease Control and Prevention (CDC) encouraged the strategic use of Twitter to effectively and inexpensively reach the public with timely COVID-19 information. Twitter worked with the WHO, CDC, and academic institutions to identify experts to provide credible updates on the topic of COVID-19.[13] The ID pharmacist (@idpharmd) applied and received Twitter's blue badge "verification status" letting people know that the account of public interest is authentic. Importantly, five pharmacists on this paper received Twitter verification status to help provide accurate and reliable COVID-19 education to the public. Table 2 lists Twitter-verified accounts of selected ID pharmacists with over 2000 followers. In addition, we provide examples of COVID-19 pharmacy services from their place of work in Table 3.

2.2 | IDStewardship, Miami Florida

IDStewardship is an online educational platform for ID pharmacists and antimicrobial stewardship.[14] Developed and managed by a U.S. ID

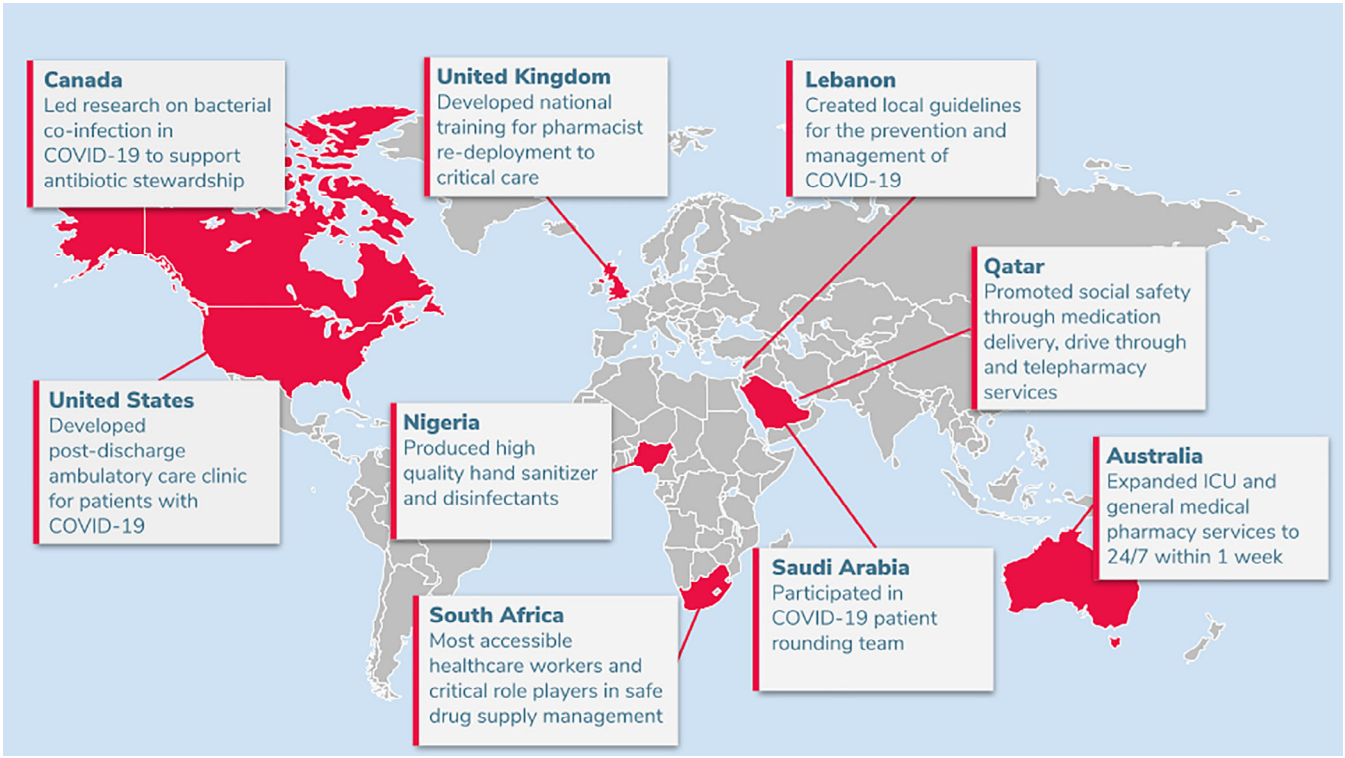

FIGURE 1 Map highlighting pharmacist's global contributions during the coronavirus disease 2019 (COVID-19) pandemic. ICU, intensive care unit

pharmacist with the support of other clinical pharmacist contributors from around the world, the IDstewardship.com blog and @IDstewardship social media profiles are free and open access to its over 41 000 Twitter and Instagram followers. These outlets provide an innovative way of disseminating information that is reliable and relevant in our technologically connected world during the advancement of this pandemic.

The COVID-19 resource for pharmacist blog page is regularly updated with clinically relevant COVID-19 pharmacotherapy literature.[14] The repository of COVID-19 resources has been of such value that over 180 000 people registered an excess of 300 000 page views to it between March 14, 2020 and July 14, 2020. In addition to the COVID-19 resource page, blog articles on the role of the pharmacist during the COVID-19 pandemic, updates on remdesivir and other drug therapies for COVID-19, the impact of COVID-19 on pharmacy students, and COVID-19 testing have received over 32 000 cumulative page views.

To increase awareness about relevant COVID-19 concepts and information as it was published, IDStewardship used Instagram posts with memes and emojis while providing concise dialogue with references. For example, one post providing a visual representation of bacteria spread by respiratory droplets was shared by over 4000 users, registered over 3200 likes, and reached over 30 000 unique Instagram accounts. Two pharmacists on this paper, one from USA (TG) and one from Canada (BL) co-hosted several monthly Twitter Chats (#ASPChat) to engage hundreds of colleagues in an international, interdisciplinary discussion about antimicrobial stewardship in COVID-19. The May 2020 Twitter chat produced over 1.5 million impressions and had 106 global participants. Figure 2 is designed to engage and educate the news media, the public, and politicians on the essential roles of pharmacists during the COVID-19 global pandemic.

3 | UNITED KINGDOM

3.1 | Public Health England

Pharmacists in the United Kingdom (UK) have contributed to the strategic management of COVID-19 directly and indirectly. This has included leading on public health interventions, clinical and medicines supply management (national and local), as well as policy changes. Examples of direct response have included leading work on the national medicines supply chain especially for critical care medicines for ventilated patients and anti-infectives, changes to Misuse of Drug Regulations, supporting easier access to medicines in hospices and care homes, measures to reduce health inequalities, lobbying government to effect policy change, and developing national training guidance to support pharmacist redeployment to critical care settings, surveillance of antimicrobial use, and development and implementation of interventions to tackle antimicrobial resistance in the context of the COVID-19 pandemic.

Pharmacists also provided leadership and oversight into new public health roles and interventions (Table 3). Within hospitals, pharmacists were required to work outside their usual scope of practice including redeployment to intensive care units (ICU), managing COVID-19 clinical trials, upscaling sterile production units to

TABLE 2 Twitter-verified accounts of selected infectious diseases pharmacists with over 2000 followers

Name	Twitter handle	Followers
Authors of this paper		
Diane Ashiru	@DrDianeAshiru	5724
Khalid Eljaaly	@Khalideljaaly	14 700
Tim Gauthier	@IDstewardship	14 300
Debra Goff	@idpharmd	8050
Brad Langford	@BRxAD	3901
Other pharmacists		
Sam Aiken	@OncIDPharmD	2119
Chris Bland	@blandman19	2122
Susan Davis	@IDPharmProf	3423
Jason Gallagher	@JGPharmD	7882
Emily Heil	@emilyheil	3101
Betsy Hirsch	@EB_Hirsch	3334
Melissa Johnson	@IDPharmacist	2794
Julie Ann Justo	@julie_justo	3098
Jamie Kisgen	@KisgenUF	3243
Monica Mahoney	@mmPharmD	6671
Erin McCreary	@ErinMcCreary	6567
Marc Scheetz	@IDPharmacometrx	2587
Society of ID Pharmacists	@SIDPharm	14 600

compound and supply increased volumes of ready-to-administer parenteral medicines to reduce work for nurses wearing full personal protection equipment (PPE), as well as adapting medicine policies to ensure they are fit for use in the current pandemic climate. Community pharmacies remained open to the public providing reassurance and advice on medicines and illnesses at a time when other frontline health care staff moved to remote consultations. More than 100 examples of notable practice in community pharmacies during the COVID-19 pandemic have been identified by regulatory inspectors.[15] A number of UK pharmacists through the Commonwealth Partnerships for Antimicrobial Resistance and Commonwealth Pharmacists Association provided support outside the UK to colleagues in four African Commonwealth countries.[16]

Most pharmacists across the country continued to maintain and contribute to their usual roles while taking on additional adapted or new roles for COVID-19. COVID-19 has led to some beneficial changes to practice within the UK system including unlocking of significant changes country wide and work is ongoing to consider how they can be embedded in future practice.

4 | AUSTRALIA

4.1 | Alfred Health, Melbourne, Victoria

Australian pharmacists have been essential members of the COVID-19 multidisciplinary team response in both the hospital and community setting. During the public health response and implementation of Stage 4 restrictions in Melbourne, community pharmacies were considered an essential service. Pharmacists continued to facilitate medication supply and provide clinical care such as influenza vaccinations. Clinical pharmacists sit on the National COVID-19 Clinical Evidence Taskforce to develop national, evidence-based living guidelines for the clinical care of people with COVID-19. A dynamic medication demand model was developed and used to project critical medication usage and availability across Australia and has been made available to government hospitals. Approximately 240 pharmacists, technicians, intern pharmacists, pharmacy students, and pharmacy support staff at Alfred Health have rapidly adapted and maintained ongoing pre-pandemic levels of clinical care throughout the pandemic. In addition to those services included in Table 3, pharmacists were directly involved with the health service operational response including redesign of hospital COVID-specific wards and implementation of dedicated COVID-treating teams. Within a one-week period, the existing 7-day-a-week clinical pharmacy service to the ICU and General Medical Unit was expanded to a 24-hour service. All pharmacists participating in this service were credentialed for Partnered Pharmacist Medication Charting (PPMC) to assist with the prescribing of medications, ordering of pathology investigations, and documentation during ward rounds.[17] Rapid adoption of technology, including virtual attendance on inpatient ward rounds limited to two medical staff, has enabled ongoing service provision while keeping both patients and pharmacists safe. Telehealth was implemented with pharmacists providing ongoing clinical reviews for rural and regional outpatients of existing statewide services including solid organ transplantation. Pharmacy students were recruited and trained in roles usually undertaken by pharmacy technicians in case of need. Pharmacy technicians and pharmacy students were teamed alongside nursing staff in COVID-specific wards to assist in medication supply and administration.

5 | CANADA

5.1 | Public Health Ontario, Toronto, Ontario

5.1.1 | Hotel Dieu Shaver Health and Rehabilitation Centre, St. Catharines, Ontario

Pharmacists at Public Health Ontario (PHO) and Hotel Dieu Shaver Health and Rehabilitation Centre (HDSHRC) focused their efforts largely on keeping patients, families, and health care providers safe during the pandemic. Prevention of transmission of COVID-19 was a key objective of their work. Pharmacists at PHO provided advice to health care stakeholders in Ontario and provincial government partners on safe medication use during the pandemic. This included recommendations to consolidate medication administration times to reduce the use of PPE and decrease exposure time to prevent transmission between patients and health care providers. As another effort to prevent COVID-19 spread, pharmacists provided advice on the appropriate use of nebulizers, metered dose inhalers, non-steroidal

TABLE 3 Pharmacist's roles in COVID-19 patient care

	United States	United Kingdom	Saudi Arabia	Canada	Qatar	South Africa	Lebanon	Nigeria	Australia
Inpatient pharmacy services									
1. Drug therapy									
Develop COVID-19 medication guidelines/ protocols	X	X	X	X			X	X	X
Monitor COVID-19 medication (QTc, labs)	X	X	X	X	X	X	X		X
Identify therapeutic medication alternatives	X		X			X	X		X
Identify and standardize priority medicines including standard dosing to support managing supply chain		X	X				X		X
Streamline medication to simplify administration times	X	X	X	X			X	X	X
Assess patient candidates for COVID-19 medication	X	X	X	X	X	X	X	X	X
Assist with investigational new drug applications	X	X	X	X	X	X		X	X
Monitor compliance to local COVID guidelines	X	X	X	X	X	X	X	X	X
Monitor compliance to local ASP guidelines	X	X	X	X	X	X	X	X	X
Convert nebulizer use to metered dose inhalers	X		X				X		X
2. Process changes									
Direct involvement in disaster planning preparation and response	X	X	X	X	X	X	X	X	X
Assist in setting up pharmacy services for emergency overflow COVID-19 hospital or new patient care units	X	X	X	X	X	X	X	X	X
Consolidate medication deliveries	X	X	X	X	X	X	X	X	X
Increase ward stock and compounding to reduce work for nurses wearing full PPE	X	X	X	X	X	X	X	X	X
Mitigate drug shortages	X	X	X	X	X	X	X	X	X
Manage supply chain interruptions	X	X	X		X	X	X	X	X
Support national medication supply monitoring and allocation to prevent stock piling		X	X			X	X		X
Diagnostic stewardship, work with microbiologist and infection control to convey COVID-19 test results	X	X	X		X	X		X	X
Assist with screening patients in the emergency department	X	X							
Establish a pharmacists communication network	X	X	X	X	X	X		X	X
Assist in the COVID-19 caLL center answering consumers and healthcare workers questions	X				X				
Document pharmacists interventions	X	X	X	X	X	X	X	X	X
Co-ordinate multi-hospital critical drug supplies					X	X			X
Make Code Blue COVID-19 kits with medications for resuscitation and intubation	X		X						

TABLE 3 (Continued)

	United States	United Kingdom	Saudi Arabia	Canada	Qatar	South Africa	Lebanon	Nigeria	Australia
3. PPE preservation									
Move IV pumps to outside of patients room	X		X						
Streamline drug regimens for nurses workflow	X	X	X	X	X	X		X	X
Work from home or hospital office	X	X	X	X	X			X	X
Participate in virtual patient care rounds	X	X	X	X	X			X	X
Review and verify medication orders	X	X	X	X	X	X		X	X
4. Education									
Provide multi-media interviews and articles for consumers	X		X		X		X		
Analyze primary literature to make rapid COVID-19 medication decisions	X	X	X	X	X	X	X	X	X
Develop COVID-19 protocols, guidelines, and updates	X	X	X	X		X	X	X	X
Provide COVID-19 webinars, podcasts, zoom lectures, blogs	X	X	X	X	X	X	X	X	X
Develop training resources to upskill pharmacists required to work outside their usual scope of practice	X	X	X				X		X
Outpatient and community pharmacy practice									
Assist in setting up a COVID-19 clinic	X				X			X	
Manage anticoagulant monitoring	X	X	X		X			X	
Extend chronic medication supplies	X	X	X		X	X		X	X
Participate in COVID-19 screening	X			X					
Provide COVID-19 testing	X			X					
Provide COVID-19 test results with recommendations				X	X				
Home delivery of medication	X	X		X	X			X	X
Provide COVID-19 home kits (thermometer, antipyretics, disinfectants, masks)	X				X			X	
Provide information on COVID-19 clinical trials	X	X	X	X	X			X	
Assist vulnerable patients	X	X		X	X		X	X	X
Public health interventions									
Promoting physical activity during lock down for targeted groups		X							
Telehealth promotion with patient education	X	X	X			X			
COVID-19—interventions to tackle health inequalities		X							
Research									
Rapid development and management of investigational COVID-19 medicines for clinical research	X	X	X	X	X				X
Publication of COVID research	X	X	X	X	X	X	X		X

anti-inflammatory drugs, and intranasal medications in patients with COVID-19.[18]

From an antimicrobial stewardship perspective, an interdisciplinary team co-led by pharmacists is performing rapid reviews and meta-analyses on bacterial co-infection[19] and antibiotic prescribing in patients with COVID-19 in an effort to evaluate and mitigate the impact of COVID-19 on another global public health threat - antibiotic resistance. Patient educational resources were developed by

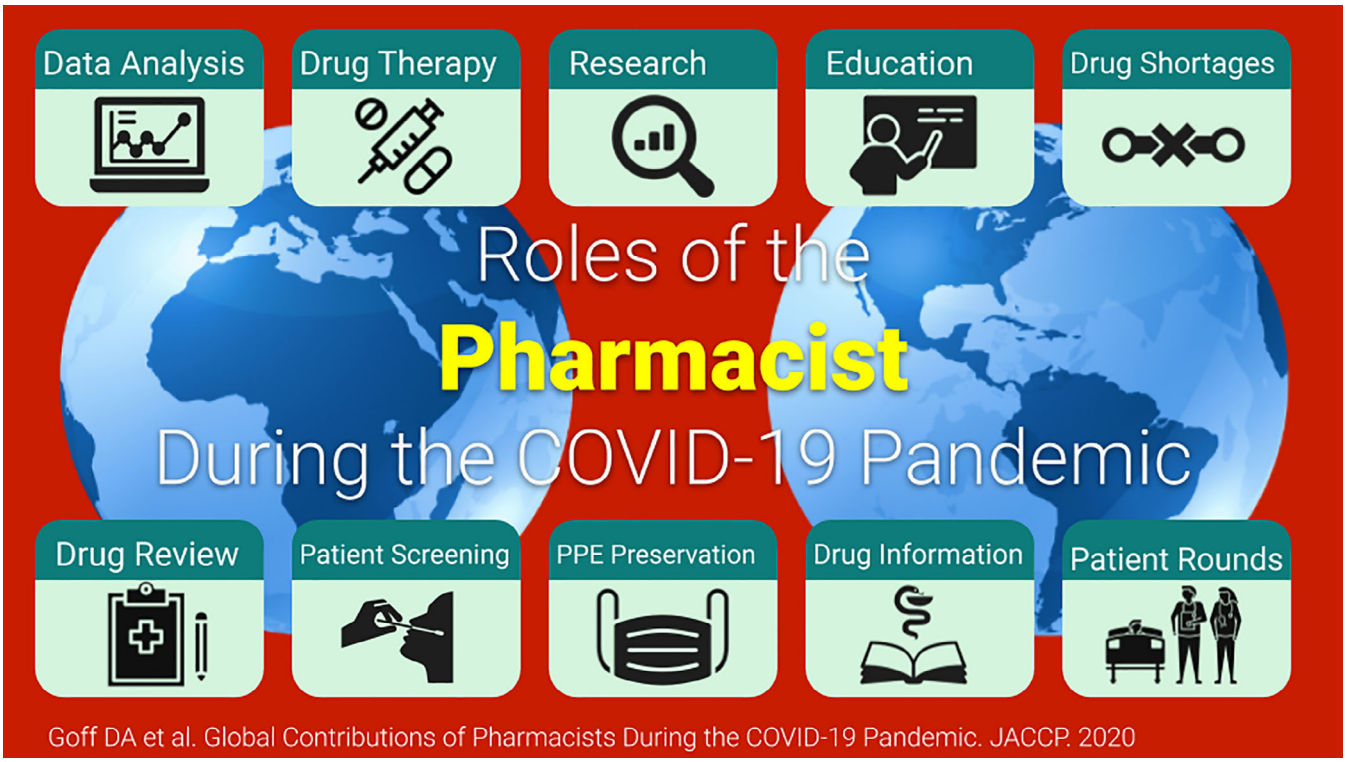

FIGURE 2 Infographic of the roles of pharmacists during the COVID-19 pandemic. PPE, personal protective equipment

pharmacists from various institutions along with patient advisors to address common myths regarding medications in COVID-19 (eg, dispelling myths about the role of antibiotics in COVID-19, the safety of angiotensin-converting enzyme [ACE] inhibitors, and NSAIDs in infected patients).[20]

At HDSHRC, pharmacists and pharmacy technicians modified the medication dispensing and administration process including the safe handling of returned medications. The pharmacy team also adapted the medication management system on the patient care units to reduce crowding and ensure adequate physical distancing at the automated dispensing cabinets. Given the rapid changes to the medication supply chain during COVID-19, managing medication shortages and recommendation of alternative pharmacotherapeutic options was another key role. Pharmacists also educated hospital staff and physicians on prevention and management of COVID-19 by setting up a web forum to address common pharmacotherapy-related questions.

5.2 | SAUDI ARABIA

5.3 | King Abdulaziz University and Hospital, Jeddah

At King Abdulaziz University (KAU) and Hospital (KAUH), faculty members, pharmacists, pharmacy technicians, residents, and students had a role in optimizing pharmacy services for COVID-19 in the inpatient and outpatient settings (Table 3). During the beginning of the pandemic, a COVID-19 patient rounding team was established including ID physicians and ID pharmacists to discuss management of patients and create COVID-19 protocols. To decrease the spread of COVID-19, restriction of antimicrobial agents changed from being paper-based to an electronic process. ID pharmacists conducted COVID-19 webinars and news interviews. Webinars were presented to health care providers invited by the Saudi Ministry of Health, the General Department of Medical Services at the Ministry of Interior, the Saudi Pharmaceutical Society, the Saudi Society of Clinical Pharmacy, the Egyptian Drug Authority, and the Saudi Society of Emergency Medicine. One live webinar invited by the Saudi Commission for Health Specialties was attended by over 12 000 health care providers from different countries and was featured on the American College of Clinical Pharmacy website.[21] This webinar aimed to provide an update on investigational COVID-19 medications and how to mitigate a drug shortage during the pandemic. Another webinar was hosted by the Health Promotion Center in the KAU and focused on providing COVID-19 information to the public. One video was invited by the US SIDP as part of their free online COVID-19 resources. ID pharmacists published COVID-19-related research including randomized clinical trials (RCT).[22-24] One ID pharmacist is a member of several data safety-monitoring board of RCTs of COVID-19 patients and received a COVID-19 grant to study COVID-19 investigational agents. The faculty of pharmacy at KAU created new lectures and activities to enrich the COVID-19 content of Doctor of Pharmacy (Pharm.D.)

curriculum, and some faculty members served in the KAUH pharmacy department during the pandemic. A COVID-19 rotation was created for pharmacy interns. The rotation was precepted by clinical faculty members (ID, critical care, parenteral nutrition, and internal medicine). Investigational COVID-19 medications were discussed, and interns had several group assignments to cover various aspects of COVID-19 pharmacotherapeutic management. Patient cases were discussed in light of existing scientific evidence and antibiotic stewardship interventions were delivered, particularly discontinuing broad-spectrum antimicrobial agents in patients with low likelihood of concomitant or secondary infections, and intravenous to oral antimicrobial conversion.

6 | QATAR

6.1 | Hamad Medical Corporation

Hamad Medical Corporation (HMC) is the main governmental health care entity in the state of Qatar and consists of 12 general and specialized hospitals. Across the corporation and under the leadership of the pharmacy executive office, over 400 pharmacists, pharmacy technicians, and residents demonstrated extraordinary dedication and outstanding performance during the COVID-19 pandemic. The pharmacy department promoted social safety by initiating a medication home delivery service for new prescriptions received from tele-clinics and medication refills. Social safety was also promoted inside the hospital through staff redistribution, installing glass shields in outpatient pharmacies, and providing appropriate PPE for all frontline providers. Frequently prescribed medications for discharged COVID-19 patients were made available in the emergency department to reduce patient contact within the hospital.

HMC's pharmacy-led anticoagulation clinic initiated a drive-through service to monitor international normalized ratios (INRs) and make therapeutic changes as appropriate.[25] The drug information and toxicology center initiated a national help line to the public to answer general questions about medications and provide medication counseling if necessary. A team of clinical pharmacists were involved in the country's core team for COVID-19 responsiveness. Pharmacists were involved in analyzing published evidence and creating treatment protocol for COVID-19, which was updated frequently, to match the dynamic changes in published research.

A selected team of clinical pharmacists was assigned to be frontline responders in the new COVID-19 hospitals located across Qatar. Those pharmacists participated in daily rounds and provided clinical interventions. Another team of operational pharmacists was redistributed to serve new hospitals. Drug supply teams worked around the clock to ensure appropriate and sufficient supply of COVID-19 medications. The drug supply team monitored global drug shortages and carried out medication stocking and redistribution as appropriate. The continuous pharmacy professional development (CPPD) office created a public website that contained updated information about COVID-19, circulated educational material for pharmacists through e-mail and through a communication hub that was created for employees. The CPPD office initiated a number of recorded and live educational events to empower pharmacists with the knowledge needed to provide optimum patient care and public awareness. One live event was with OSUWMC pharmacists who shared their experience with critically ill COVID-19 patients. Pharmacists across the corporation are involved in published and ongoing COVID-19 investigational and clinical outcomes' research projects.[26,27]

7 | SOUTH AFRICA

7.1 | Netcare Hospital Group Ltd

Pharmacists within the 54 Netcare private hospital network played a significant role in the maintenance and supply of critical medications used for patients admitted for COVID-19. Novel COVID-19 pharmaceutical services provided include: the preparation of material "packs" for commonly used surgical items (eg, admission packs, ventilation packs, and catheter packs as well as therapeutic packs which were developed in collaboration with physicians) to ensure the prompt and seamless supply of medication within the wards. To mitigate possible transmission risks associated with paper prescription charts moving between wards and the pharmacy, an electronic process was promptly created whereby scanned copies of prescriptions were e-mailed to the pharmacy. Furthermore, pharmacists have maintained the safety and stewardship monitoring of all COVID-19-related therapies including appropriate dosing, review of drug interactions, and clinical response to therapies via prescription chart review. As per recommendations by the WHO and the South African National Department of Health (NDoH), a pharmacist designed a Monitored Emergency Use of Unregistered Interventions (MEURI) study, which aimed to ensure the safe and effective monitoring of patients receiving off-label therapeutics for COVID-19 within the hospital network outside of a clinical trial. In addition, two pharmacists contributed a lecture "Netcare COVID-19 Lecture Series" which reviewed COVID-19 therapy to health care providers within the network. Interactive COVID-19 dashboards were developed by a pharmacist and author of this paper (AM) to track drug utilization, patient demographics, and drug supply management in real time.

7.2 | Sefako Makgatho Health Sciences University, Pretoria

Pharmacists participated in assisting South Africa's NDoH rapid review process to evaluate emerging therapies for COVID-19 to assist evidence-based medicine utilization. Further to this, pharmacists published a national COVID-19 guideline for pharmacists.[28] Subsequent to the publication, two webinars were conducted to educate 120 South African and 238 Kenyan pharmacists.

South Africa is one of 39 countries participating in the WHO Solidarity Trial testing existing and new drugs to treat COVID-19 and

ensure equitable access. Pharmacists are assisting the research teams with medication oversight. The University staff initiated the manufacturing of hand sanitizers benefiting patients, hospital staff, and the University. Access to health care is a major challenge due to lack of public transportation during lockdown. Pharmacists provided 4-month supplies of medicines for patients with chronic conditions to avoid repeated visits.

8 | LEBANON

8.1 | American University of Beirut Medical Center, Beirut

Since the first COVID-19 case emergence on February 21, 2020, Lebanese pharmacists have been on the frontlines of the pandemic playing different key roles at the national level, in the community, in hospitals, and in the academic field.[29] First, in terms of guidance and leadership, pharmacists were assigned managerial roles in the Ministerial National Committee on COVID-19 (NCC) and in the Ministry of Public Health (MOPH) since the beginning of the pandemic and were proactive in implementing successful emergency response plans despite the harsh economic and political unrest.[30] Clinical pharmacists played essential and unique roles within hospital multidisciplinary teams. At American University of Beirut Medical Center (AUBMC), the ID pharmacists participated in the critical appraisal of the tsunami of information and literature published to develop local clinical guidelines for prevention and management of COVID-19.[31] In the frontlines, the clinical pharmacists performed daily comprehensive medication reviews and pharmacotherapeutic monitoring of COVID-19 patients. The Order of Pharmacists in Lebanon issued a guidance for community pharmacists to promote their role in educating the public on disease prevention and in referring suspected patients to adequate COVID-19 centers. Retail pharmacists played important roles as gatekeepers in containing shortages in drugs and medical supplies by controlling over-dispensation and black market pricing.[32] Finally, many pharmacists in the academic sector were involved in delivering online education and training sessions on COVID-19 prevention and management measures, as well as in leading and publishing national studies.[31] Despite the economic crisis, the fragile and fragmented health care system, and the lack of recognition, Lebanese pharmacists were able to prove high impact and support during the pandemic. Their involvement contributed to the successful and effective emergency response of our country.

9 | NIGERIA

9.1 | The University of Nigeria, Nsukka, Enugu

Pharmacists at the University of Nigeria Teaching Hospital are part of the frontline team at the hospitals' newly launched testing and treatment center.[33] They dedicate their time to prescription filling and medication stewardship managing of over-prescribed anti-viral agents, antibiotics, and immune boosters in the face of no approved treatment for COVID-19. Research groups and individual academic pharmacists at the Faculty of Pharmaceutical Sciences are optimizing and upscaling their anti-viral research and immune boosting herbal remedies as possible treatment options for COVID-19. Importantly, a pharmacist from the Department of Clinical Pharmacy is a part of the National Scientific Advisory Committee on verification of COVID-19 cure claims.

Pharmacy laboratories at the Departments of Pharmaceutics and Pharmaceutical Technology, as well as the Institute of Drugs-Herbal Medicines and Excipients Research, have augmented the local production of standard and quality sanitizers and disinfectants. This production came in the face of illegal and large-scale production of sub-standard products by unapproved chemical product vendors. These products are currently being utilized in hospitals across Enugu State in Nigeria and are sold at competitively less expensive prices at pharmacies.

The Pharma Extra Academy for Entrepreneurship and Creativity at the University of Nigeria headed by an academic pharmacist and author of this paper (CMU) conducts a weekly online COVID-19 lecture series for at-home pharmacy students and new pharmacists to improve their competency skills in the fight against the pandemic. Pharmacists in the Africa Resource Centre Nigeria Hub, which includes a number of pharmacists from the Department of Clinical Pharmacy, are helping in the design of responsive health supply chain systems for efficient distribution of medicines and PPE for different state governments.[34]

10 | CONCLUSION

Worldwide, pharmacists are providing essential frontline care to COVID-19 patients in hospitals, clinics, community pharmacies, long-term care, nursing homes, physician offices, and national and public health. The complexity of diagnosing and treating COVID-19 patients in the hospital, post discharge or as an outpatient, requires a multidisciplinary team of experts which includes pharmacists. While patients and physicians turn to telehealth virtual visits, pharmacies remain open and provide one-on-one access to the pharmacist, an essential frontline health care provider. The news media, the public, and politicians often overlooked pharmacists as essential frontline health care providers during the COVID-19 pandemic but the list of contributions by pharmacists from nine countries provided in this article can change this perspective.

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CONFLICT OF INTEREST

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