



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

# Pharmacists' role in infectious pandemics: illustration with COVID-19

Grace Earl<sup>1</sup>, Lisa M. Cillessen<sup>2</sup>, Heather Lyons-Burney<sup>2</sup>, Paul O. Gubbins<sup>2,3</sup>, Andrew W. Mina<sup>3</sup>, David M. Silverman<sup>4</sup>, Carmela M. Silvestri<sup>5</sup> and Maria Leibfried<sup>1</sup>

<sup>1</sup>Fairleigh Dickinson University, School of Pharmacy and Health Sciences, Florham Park, NJ, United States, <sup>2</sup>University of Missouri-Kansas City School of Pharmacy at Missouri State University, Springfield, MO, United States, <sup>3</sup>St. Michael's Medical Center, Staten Island, NY, United States, <sup>4</sup>Prime Healthcare, Newark, NJ, United States, <sup>5</sup>Med-Therapy Consults LLC, Flemington, NJ, United States

## 50.1 Introduction

This chapter describes salient issues impacting pharmacists' response to the Coronavirus disease. A new coronavirus (CoV-2) was identified as the cause of a viral respiratory illness known as sudden acute respiratory syndrome (SARS-CoV-2) [Centers for Disease Control and Prevention (CDC), 2020a]. The World Health Organization (WHO) (2020b) established nomenclature of a novel coronavirus that had emerged in 2019: nCoV-19, or COVID-19. On March 11, 2020 the WHO formally declared a global pandemic [World Health Organization (WHO), 2020a]. Severely ill patients hospitalized for COVID-19 who developed coagulopathies were associated with increased mortality (Thachil et al., 2020). The International Society of Thrombosis and Haemostasis published interim guidelines for managing COVID-19 coagulopathy (Thachil et al., 2020). On May 15, 2020 the CDC reported new surveillance revealing a multi-system inflammatory syndrome in children (MIS-C), which was associated with persistent fever, multiorgan involvement, and elevated inflammatory markers [Centers for Disease Control and Prevention (CDC), 2020b]. The onset of MIS-C occurred after resolution of COVID-19 infection in children younger than 21 years of age [Centers for Disease Control and Prevention (CDC), 2020b].

Pharmacists responded to protect the health and safety of *patients and pharmacists and pharmacy technicians in the setting of a national as well as global emergency pandemic*. Pharmacists were advocating for expansion of pharmacists' scope of practice to state and federal policymakers to practice at the top of their license. Numerous challenges are faced by pharmacists, healthcare professionals, and administrators as stewards

for appropriate medication use and safety and managing drug shortages. Interprofessional communication is mandatory for pharmacists in all practice settings who are conferring with physicians to discuss the balance of risks versus benefits of COVID-19 drug therapies, develop treatment algorithms, and triage patients in the community based on symptomatology and risks. In inpatient setting, pharmacists were collaborating with physicians to design novel treatment algorithms fostering a systematic approach to off-label drug treatments for COVID-19 infections. Due to the unprecedented need to isolate patients, pharmacists were evaluating the patients' medication list and recommending less frequent dosing strategies. The pandemic was impacting individual states. State governors communicated critical budgetary gaps due to business closures that enforced stay-at-home isolation policies. Pharmacists and pharmacy administrators were dealing with the urgency of drug shortages and burgeoning financial expenditures of COVID-19 drug therapies. The Federal Emergency Management Administration (FEMA) was aware of disruptions in drug supply and was managing the US (United States) drug stockpile [Federal Emergency Management Agency (FEMA).gov, 2020].

There are specific sections in the chapter addressing practice issues, including the pharmacist in the community, point-of-care-testing (POCT), critical care and the health-system, and long-term care (LTC) settings. In addition, the response of academic pharmacy is included to describe efforts to continue teaching pharmacy students. Pharmacists everywhere were making important contributions employed in practice and nonpractice roles in academic pharmacy, government and state agencies, scientific research, professional organizations, and the pharmaceutical industry.

The chapter is not all-encompassing but emphasizes the response in the US and within regions to inform the readers of principles that may be applied to this ongoing response and future responses to an infectious pandemic.

### 50.2 Pharmacists’ response to COVID-19

Pharmacists in the US have responded rapidly, bravely, and with professional accountability to confront the COVID-19 infectious pandemic. On March 13, 2020 the president of the US, who holds the highest executive office, declared a nationwide emergency in response to the COVID-19 infection and concerns for public safety (White House.gov, 2020).

The infection was initially prominent in “hot spot” areas in the US, including Washington State, New York, and New Jersey (Department of Health Washington State 2019; New York State Department of Health, 2020; New Jersey Department of Health, 2020). The Johns Hopkins COVID-19 Dashboard provided real-time case tracker reporting for the globe (Johns Hopkins University & Medicine, 2020). Based on COVID-19 testing, the infectious cases were doubling rapidly.

Federal and state government leaders, including agency administrators, were active in allocating resources (Figs. 50.1 and 50.2). These leaders directly impacted pharmacy practice, health system resources, emergency management resources, and other areas by issuing executive actions or directives. The US Vice President was placed in charge of the White House Corona Virus Task



FIGURE 50.2 State agencies.

Force, and critical agencies involved in the response were Health and Human Services (HHS) and Federal Emergency Management Agency (FEMA). The Secretary of the Department of Health and Human Services was tasked with coordinating the federal government response to the COVID-19 infection [Health and Human Services (HHS), 2020].

In the US, pharmacy professionals were preparing and training personnel in administrative and engineering controls and use of personal protection equipment (PPE). Pharmacists and administrators were evaluating drug



FIGURE 50.1 Federal agencies.

supplies and formularies in health systems. Scientific and life science publishers were rapidly publishing news and reports on potential treatments for COVID-19 infection. The use of social media was an effective tool to alert the public to these plausible drug therapies.

### 50.3 Pharmacy scope of practice

The practice of pharmacy and scope of practice in the US is regulated by the individual states. Pharmacy practice is also impacted by state and federal agencies that can issue executive directives, guidance statements, and regulations (see Figs. 50.1 and 50.2). The Board of Pharmacy in each state may respond to federal declaration or guidance during the state emergency period using an administrative order. It is important to note that these declarations and guidance statements that have the potential to impact pharmacy practice within a state must be authorized at the state level as (1) state guidance document, (2) relaxation of a state regulation, or (3) a waiver system. The Board of Pharmacy may place an expiration date on the waiver, which is likely to end when the state and/or federal emergency ends. In the current environment, pharmacists and pharmacies can contact the Board of Pharmacy to request a waiver to regulations for maintaining pharmacist–pharmacy technician ratios, consolidating pharmacy services to work at remote sites, and changing operational hours (opening–closing times) (New Jersey Division of Consumer Affairs, 2020). State pharmacy organizations may issue notifications to assist pharmacists in interpretation of laws and post repositories of these changes on their websites [National Alliance of State Pharmacy Associations (NASPA), 2020a]. In the presence of drug shortages,

compounding pharmacies affected by disruptions in supplies of PPE were offered guidance by HHS [Federal Emergency Management Agency (FEMA).gov, 2020].

### 50.4 Pharmacists' response in the community

Pharmacists are healthcare providers who serve their communities by providing immunizations, self-care advice; dispensing prescription medications; and providing counseling on prescription and over-the-counter medications. They deliver care to the community in independently owned pharmacies (single owner or small number of owners), chains of pharmacies operating in regions or nationally, as well as pharmacies owned by food and beverage stores and general merchandise stores. Pharmacists are accessible healthcare professionals during a pandemic and can effectively triage patients based on best practices [National Community Pharmacists Association (NCPA), 2020]. Patients deemed to be a high risk can be directed to a physician, or provider, and/or to an emergency department [National Community Pharmacists Association (NCPA), 2020]. Pharmacists dispense and counsel patients on COVID-19-specific treatments, including bronchodilator inhalers for dyspnea, glucocorticoid antiinflammatory drugs (prednisone) following recovery from acute lung disease, and drugs for symptomatic conditions. Patients were prescribed controlled drug substances, including opioids for analgesia. In addition, pharmacists continued to dispense medications and provide support to patients with acute self-limiting and chronic conditions.

**TABLE 50.1** Reliable information sources.

| US government organizations                      |   |
|--|---|
| Food and Drug Administration                     | <a href="https://www.fda.gov/drugs/drug-safety-and-availability">https://www.fda.gov/drugs/drug-safety-and-availability</a> |
| Federal Emergency Management Agency (FEMA)       | <a href="https://www.fema.gov/coronavirus/rumor-control">https://www.fema.gov/coronavirus/rumor-control</a>                 |
| US Pharmacy Organizations                        |   |
| American Pharmacists Association                 | <a href="https://www.pharmacist.com/coronavirus">https://www.pharmacist.com/coronavirus</a>                                 |
| American Society of Health System Pharmacists    | <a href="https://www.ashp.org/COVID-19">https://www.ashp.org/COVID-19</a>   |
| National Alliance of State Pharmacy Associations | <a href="https://naspa.us/resources/">https://naspa.us/resources/</a>   |
| National Association of Boards of Pharmacy       | <a href="https://nabp.pharmacy/">https://nabp.pharmacy/</a>   |
| National Community Pharmacy Association          | <a href="https://ncpa.org/coronavirus-information">https://ncpa.org/coronavirus-information</a>                             |

(Continued)

**TABLE 50.1** (Continued)

| <b>International pharmacy organizations and agencies</b>        |   |
|---|---|
| Federação Brasileira de Farmacêuticos (Brazil)                  | <a href="https://www.fenafar.org.br/">https://www.fenafar.org.br/</a>   |
| Canadian Pharmacists Association                                | <a href="https://www.pharmacists.ca/advocacy/covid-19-information-for-pharmacists/">https://www.pharmacists.ca/advocacy/covid-19-information-for-pharmacists/</a>   |
| Chinese Pharmaceutical Association                              | <a href="http://cpa.org.cn">cpa.org.cn</a>  |
| Conseil National de l'ordre des pharmaciens d'Algérie (Algeria) | <a href="http://www.ordre.pharmacien.fr/">http://www.ordre.pharmacien.fr/</a>   |
| Coronavirus Disease-19, Republic of Korea                       | <a href="http://ncov.mohw.go.kr/en/">http://ncov.mohw.go.kr/en/</a>   |
| Egyptian Pharmacists Syndicate                                  | <a href="https://eps-eg.org/">https://eps-eg.org/</a>   |
| European Association of Hospital Pharmacists                    | <a href="https://www.eahp.eu/hp-practice/hospital-pharmacy/eahp-covid-19-resource-centre">https://www.eahp.eu/hp-practice/hospital-pharmacy/eahp-covid-19-resource-centre</a>   |
| Indian Pharmaceutical Association                               | <a href="https://ipapharma.org/">https://ipapharma.org/</a>   |
| International Pharmaceutical Students' Federation               | <a href="https://www.ipsf.org/">https://www.ipsf.org/</a>   |
| National Agency for Food and Drug Administration and Control    | <a href="https://www.nafdac.gov.ng/">https://www.nafdac.gov.ng/</a>   |
| Nigeria Natural Medicine Development Agency                     | <a href="http://www.nnmeda.gov.ng/">http://www.nnmeda.gov.ng/</a>   |
| Omani Pharmacists Society                                       | <a href="https://arab.org/directory/oman-pharmaceutical-society/">https://arab.org/directory/oman-pharmaceutical-society/</a>   |
| Order of Pharmacists of Lebanon                                 | <a href="https://opl.org.lb/">https://opl.org.lb/</a>   |
| Ordre des pharmaciens du Québec                                 | <a href="https://www.opq.org/">https://www.opq.org/</a>   |
| Pharmaceutical Association of Thailand                          | <a href="http://fapa.asia/the-pharmaceutical-association-of-thailand-under-royal-patronage-fapa-member-associations-write-up-series/">http://fapa.asia/the-pharmaceutical-association-of-thailand-under-royal-patronage-fapa-member-associations-write-up-series/</a> |
| Pharmaceutical Services Negotiating Committee                   | <a href="https://psnc.org.uk/the-healthcare-landscape/covid19/">https://psnc.org.uk/the-healthcare-landscape/covid19/</a>   |
| Pharmaceutical Society of Australia                             | <a href="https://www.psa.org.au/coronavirus/">https://www.psa.org.au/coronavirus/</a>   |
| Pharmaceutical Society of Nigeria                               | <a href="https://www.psnnational.org/">https://www.psnnational.org/</a>   |
| Pharmacists Council of Nigeria                                  | <a href="http://www.pcn.gov.ng/index.php">http://www.pcn.gov.ng/index.php</a>   |
| Saudi Pharmaceutical Society                                    | <a href="https://www.saudipharmsociety.com/">https://www.saudipharmsociety.com/</a>   |
| The Korean Society of Health-System Pharmacists                 | <a href="http://www.kshp.or.kr/english/">http://www.kshp.or.kr/english/</a>   |
| The Pharmaceutical Society of Japan                             | <a href="https://www.pharm.or.jp/eng/">https://www.pharm.or.jp/eng/</a>   |
| The Pharmaceutical Society of Korea                             | <a href="http://www.psk.or.kr/">http://www.psk.or.kr/</a>   |
| <b>Publishers</b>   |   |
| New England Journal of Medicine                                 | <a href="https://www.nejm.org/coronavirus">https://www.nejm.org/coronavirus</a>   |
| The Lancet  | <a href="https://www.thelancet.com/coronavirus">https://www.thelancet.com/coronavirus</a>   |
| <b>Public health organizations</b>                              |   |
| Centers for Disease Control and Prevention                      | <a href="https://www.cdc.gov/coronavirus/2019-ncov/">https://www.cdc.gov/coronavirus/2019-ncov/</a>   |
| WHO   | <a href="https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public/myth-busters">https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public/myth-busters</a>   |

WHO, World Health Organization.

Pharmacists are accessible in-person and by phone to dispel rumors and myths, to reassure patients and stave off panic. Resources available to dispel rumors and misinformation were available from FEMA and WHO. Many organizations were providing reliable information on the Internet (Table 50.1).

## 50.5 COVID-19 treatments and medication safety

With increasing awareness of the infectious nature of COVID-19 and rising number of cases, primary and specialty care medical practices and health-system outpatient practices implemented telehealth strategies to deliver patient care at a distance. Community pharmacists continued to provide in-person services, utilize drive-through options for delivering prescriptions, implement curbside options, and be accessible to patients using the telephone or other digital methods [Centers for Disease Control and Prevention (CDC), 2020c].

Pharmacists continued in their roles as accessible healthcare professionals to provide professional duties to protect the public [National Alliance of State Pharmacy Associations (NASPA), 2020b; National Community Pharmacists Association (NCPA), 2020]. Pharmacists in community settings, utilizing patient medication profiles, prospectively screen and confirm appropriate drug indication, dose, frequency of administration, precautions and contraindications, and drug interactions between patients' existing drug therapy and new prescriptions for COVID-19 treatments. Safe use of medications was a prominent concern.

Hydroxychloroquine, suggested for COVID-19 treatment, carried a known cardiovascular risk that affected the conduction system of the heart causing prolonged QT interval on the electrocardiogram (Rodén et al., 2020). The clinical impact resulted in increased risk for developing a life-threatening ventricular arrhythmia in monitored inpatient settings and while at home, outside of a monitored healthcare setting. The American College of Cardiology responded with a strong recommendation to utilize these drugs in health-system settings where patients could be

monitored with an electrocardiogram or telemetry [American College of Cardiology (ACC), 2020a]. A theoretical concern was put forward that drugs acting through mechanisms involving the renin–angiotensin–aldosterone system may increase the risk of acquiring the COVID-19 infection (Fang et al., 2020). A statement from the American College of Cardiology (ACC) (2020b) addressed these concerns. The Food and Drug Administration (FDA) (2020a) provided clarifications on misstatements concerning use of nonsteroidal antiinflammatory drugs during COVID-19 treatment.

### 50.5.1 Reliable drug information sources

Pharmacists in the community, LTC, health-system, and other practice settings conferred with physicians and prescribers to make decisions on managing drug interactions and ensuring safe dispensing of off-label COVID-19 drug therapy without substantiated evidence. Professional organizations and publishers demonstrated leadership through guidance statements and some established dashboard websites to communicate critical and emerging information on COVID-19 rapidly to their constituents (Table 50.1). Professional guidance statements called upon pharmacists as stewards ensuring appropriate and safe use of off-label medications during the COVID-19 pandemic [American Society of Health System Pharmacists (ASHP), 2020a; Alhazzani, 2020]. Biomedical and life science publishers released publications-ahead-of-print and prior to peer-review, with clear disclosure, to rapidly communicate clinical information generated from open-label nonrandomized and randomized studies, and compassionate use case series (Gautret et al., 2020; Bao et al., 2020; Grein et al., 2020). Pharmaceutical companies provided expanded access to investigational drugs for COVID-19 treatment (Box 50.1).

Health-care professionals, including pharmacists, were apprehensive on the unknown benefit to risk ratio of these off-label treatments that had not undergone scrutiny by the FDA. The American College of Cardiology released a statement on limiting COVID-19 treatments associated with life-threatening cardiac arrhythmias to inpatient use or as part of a clinical trial [American College of Cardiology (ACC),

#### BOX 50.1 Nonresearch terminology

*Case reports:* A descriptive report of experience in one patient

*Case series:* A descriptive report of experiences in multiple patients

*Open-label:* The patient and investigator are aware of the treatment that has been administered to the patient

*Compassionate use or expanded access* of an investigational drug, biologic or medical device: Providing treatment to patients for immediately life-threatening conditions or serious disease outside of a clinical trial\*

Caption: \*<https://www.fda.gov/news-events/public-health-focus/expanded-access>



2020a]. ASHP responded quickly and impressively by posting a summary table “Assessment of Evidence for COVID-19 Treatments” [American Society of Health System Pharmacists (ASHP), 2020a,2020b]. On April 21, 2020 the NIH released a guideline, meant to be a “living document” that would be updated and revised to accommodate new information, on COVID-19 treatments [National Institute of Health (NIH), 2020].

### 50.5.1.1 Pharmacists as immunizers

The SARS-Co-V2 is a novel virus that had not been identified across the globe before 2019 [World Health Organization (WHO), 2020b]. Therefore there was an absence of herd immunity since no living person had been exposed to the virus to generate antibody formation. The clinical presentation of COVID-19 infection was initially reported as severe pneumonia and, for some, acute respiratory failure necessitating mechanical ventilation. WHO reported rising number of deaths in Asia and Europe [World Health Organization (WHO), 2020a; Johns Hopkins University & Medicine, 2020] in March, 2020. There are established strategies to provide a measure of protection to patients and this involves vaccination. As health professionals in “hot spot” areas were mobilizing their first response to the COVID-19 infection, the experts were discussing the possibility to rapidly develop a vaccine against the SARS-Co-2 virus as the ultimate preventive strategy.

Pharmacists providing immunization within their community are providing an important public health service. Viral and bacterial pneumonias *are* prevalent in the community and can lead to secondary pneumonia and other serious infections [Centers for Disease Control and Prevention (CDC), 2020d]. The CDC publishes evidence-based immunization schedules that were utilized by pharmacists during the COVID-19 pandemic [Centers for Disease Control and Prevention (CDC), 2020e]. Bacterial and viral causes of pneumonia have been well characterized and are preventable with vaccines mentioned in Box 50.2. Individuals in high-risk groups such as pregnancy, cancer, immunocompromised, and those with chronic diseases have continued access to immunizations within close proximity to their homes. In specific states, pharmacists immunize

adolescents and children and would do so based on their state regulations.

To accommodate the need to reduce exposure of patients to the COVID-19 virus, the CDC released changes to the immunization schedules [Centers for Disease Control and Prevention (CDC), 2020e]. It was deemed desirable to extend the duration of a vaccine series, where possible, to a later time. Health-care professionals and patients should aim to schedule vaccines as part of other necessary visits to limit trips out of the home. This aim supports social isolation practices that eliminate person-to-person contact as a method for halting the spread of the infection. The CDC also encourages shared clinical decision-making between the patient and healthcare professional to tailor vaccination based on the patient’s preference and risk status.

### 50.5.1.2 Advocating for pharmacist expanded roles and access to PPE

Pharmacists strongly advocated for an expanded and direct role in stemming the COVID-19 infectious pandemic. Community testing for COVID-19 was set up by the department of health in states, often in outdoor settings, to track cases. As the hospitals in New York, Northern New Jersey, and other regions were beginning to see an upward trend in hospital admissions, state dashboards were reporting the number of confirmed positive test results as well as deaths (Department of Health Washington State, 2020; New York State Department of Health, 2020; New Jersey Department of Health, 2020). Prominent leaders explained there would be a surge in COVID-19 infections throughout the US [Centers for Disease Control and Prevention (CDC), 2020f].

The secretary of HHS released a guidance document supporting licensed pharmacists’ role in ordering and administering COVID-19 testing on April 8, 2020 [Health and Human Services (HHS), 2020]. This document was the impetus for states to issue executive orders or implement new guidance on the pharmacists expanded role in testing [National Alliance of State Pharmacy Associations (NASPA), 2020c]. These actions were often undertaken as emergency actions or under emergency management agencies [National Alliance of State Pharmacy Associations (NASPA), 2020c]. A response

## BOX 50.2 Vaccinations for prevention of pneumonia and other serious infections

### Bacterial infections

Pneumococcal (*Streptococcus pneumoniae*)  
*Haemophilus influenzae* type b (blood stream, and meningitis infection)  
 Pertussis (whooping cough)

### Viral infections

Viral influenza types A and B  
 Varicella (chicken pox)  
 Measles (rubeola)

from four organizations, including the American College of Clinical Pharmacy (ACCP) (2020), advocated for policymakers to codify access to and use of PPE. This action brought attention to the shortage of PPE and influenced government and state agencies in optimizing allocation of PPE to pharmacists ([American College of Clinical Pharmacy, 2020](#)).

The COVID-19 pandemic has presented a challenge to pharmacists, pharmacies, and healthcare organizations due to the infectious properties of the virus and shortages of PPE. Infection prevention and control was critical to pharmacists, in their role as immunizers. This role presented a call for action to implement best practices for adopting infection prevention and control processes, procedures, and training. The CDC released a document “Guidance for pharmacists and pharmacy technicians in community pharmacies during the COVID-19 response” [[Centers for Disease Control and Prevention \(CDC\), 2020g](#)]. The [Centers for Disease Control and Prevention \(CDC\) \(2020g\)](#) explained administrative and engineering controls as well as direct infection control processes that can be implemented in community pharmacies. Examples of these controls are in [Box 50.3](#).

These best practices were designed to protect patients, the pharmacist, and pharmacy technicians and foster a continued healthcare presence in the community. Community pharmacies provide healthcare services that are physically separated from physician offices as well as health systems. This point is especially critical as rapid spread of a virus can be detrimental to the integrity of the workforce.

## 50.6 Pharmacists' role in point-of-care testing for COVID-19

POCT involves performing clinical specimen analysis in proximity to the patient at the time and place care is provided ([Goble and Rocafort, 2017](#)). Having the capability to perform POCT during the novel coronavirus (COVID-19) pandemic enabled the rapid detection and differentiation of this virus from other pathogens that produce similar symptoms. Unlike laboratory-based diagnostic testing,

POCT enables the performance of diagnostic testing anywhere, including a pharmacy, provided the appropriate certification is in place. In addition, POCT improves convenience of and access to testing, reduces turnaround time, and preserves emergency department and clinic resources for the most severely ill. Such testing produces rapid results enabling timely institution of preventive or mitigation measures to help improve patient outcomes and public health.

### 50.6.1 Increasing testing capacity for COVID-19 with point-of-care testing

The amendment to the Public Health Services Act, known as “The Clinical Laboratory Improvement Amendments of 1988” (CLIA), promulgates federal standards for all facilities or sites in the United States that test human specimens for medical, diagnostic, preventative, or treatment purposes. Three federal agencies share complimentary responsibility for CLIA, including the Centers for Medicare & Medicaid Services (CMS), FDA, and CDC.

Under CLIA, CMS is primarily responsible for regulating all facilities and sites testing human specimens for nonresearch purposes (e.g., health assessment, diagnosis, prevention, or treatment of disease), including those performing POCT. Pharmacists and ambulatory care clinics must obtain a CLIA Certificate of Waiver from CMS and follow the requirements to perform POCT. Pharmacists should be aware of all board of pharmacy regulations impacting POCT. More information regarding the role of CMS in the CLIA program can be found at <https://www.cms.gov/Regulations-and-Guidance/Legislation/CLIA/>.

The primary responsibility of the FDA in the CLIA program is to ensure that tests are reasonably safe and effective by regulating test manufacturers and categorizing tests during their premarket authorization process. The FDA categorizes tests based on their level of complexity (eg. waived, moderate complexity, and high complexity) and potential for risk to public health. “Low-complexity” tests are “waived” because they are simple to use and either possess negligible risk of producing erroneous results or offer no reasonable risk of

#### **BOX 50.3 Administrative and engineering controls**

##### Engineering controls

- Promote 6-ft. social distancing at the pharmacy counter
- Install barriers (clear plastic, plexiglass) to shield respiratory droplets
- Clean and disinfect nonporous surfaces such as counters

##### Administrative controls

- Use telehealth or telephone contact for pharmacy services such as medication therapy management, chronic disease management, and other services
- Reschedule vaccine delivery to an extended date or during a time with minimal clients in the pharmacy
- Promote self-monitoring and use of self-monitoring devices (blood pressure monitoring, finger-stick blood glucose) at home rather than within the pharmacy



patient harm if incorrectly performed. More information regarding the role of FDA with regards to CLIA can be found at <https://www.fda.gov/medical-devices/device-advice-comprehensive-regulatory-assistance/ivd-regulatory-assistance>.

The CDC collaborates with CMS and FDA to support the CLIA program by providing analytical, research, and technical assistance to support the CLIA program. More information regarding the role of CDC in the CLIA program can be found at <https://www.cdc.gov/cliaindex.html>.

To increase the speed and capacity for testing, early in the COVID-19 pandemic, the FDA issued a policy to accelerate the commercial development of POCT for COVID-19 (Food and Drug Administration (FDA) (2020b)). The policy allowed manufacturers to market POCT for COVID-19 prior to FDA Emergency Use Authorization (EUA) review, provided several criteria were met [Food and Drug Administration (FDA), 2020b]. The policy did not address the CLIA classification of the tests; however, the FDA considers non-serological POCTs authorized under an EUA to be CLIA-waived. Thus, until the FDA determined a serological test's CLIA classification, or specified it is suitable for POCT in the EUA, only non-serological tests authorized under an EUA could be performed in properly certified, nonlaboratory settings, like pharmacies. (Gibbs et al., 2020).

### 50.6.2 Use and performance of COVID-19 tests

Several types of COVID-19 tests exist or are under development, including, molecular, antigen, and antibody methods. Each method differs in what it measures and when it could be used based on a patient's symptoms. Therefore, each type of test has a different role in testing for COVID-19. Molecular methods for detecting COVID-19 amplify nucleic acids in the viral genome. Many of the methods for POCT of COVID-19 marketed under the FDA policy are molecular tests that amplify nucleic acids by real-time reverse transcription polymerase chain reaction (rRT-PCR) or reverse transcription isothermal amplification. The rRT-PCR methods transcribe RNA into DNA and amplify specific DNA targets to measure the amount of RNA to compare to a known standard. The amplification reaction in rRT-PCR methods occurs through a series of alternating temperature cycles, which historically made conducting such tests outside a laboratory challenging. However, technological advances in instrumentation have enabled rRT-PCR methods suitable for POCT to be marketed. In addition, methods using reverse transcription isothermal amplification, like RT-loop-mediated isothermal amplification (RT-LAMP), in which the amplification reaction occurs at a constant temperature have enabled molecular diagnostic tests to be performed in patient-care settings. The genetic material of

the virus that causes COVID-19 is detectable in upper and lower respiratory specimens from a patient with an active infection. The marketed tests which have received EUA analyze nasopharyngeal, throat, or nasal swab samples and provide a semiquantitative measure of viral load. While molecular tests are useful for detecting active infections, those that are based on rRT-PCR methods take time to perform, which may limit their usefulness. Although isothermic methods, such as RT-LAMP, lessen the turnaround time, unlike the rRT-PCR platforms, the instrument that performs the test measurement typically process a single sample at a time, which precludes high-throughput testing needed to scale up to desired testing capacities. The performance of molecular tests for detection of active COVID-19 infection is summarized in Table 50.2.

Test methods that measure antigens detect protein fragments, like the surface spikes of the SARS-CoV-2 or nucleocapsid proteins, collected from nasopharyngeal or nasal swab samples. Such viral surface proteins elicit an immune response; therefore, they may serve as a marker for infection. Unlike nucleic acids that molecular tests detect, surface proteins are sufficiently large to detect without the use of amplification reactions. Moreover, antigen detection methods are typically based on lateral flow chromatographic enzyme immunoassays (i.e., an immunofluorescent assay) or latex agglutination techniques. Such techniques typically produce a visual readout without the need for special equipment and can be performed with little or no training. Thus antigen tests should be easier to perform than molecular tests. However, to select the ideal test target to detect, the structure and function of important viral surface proteins must be fully elucidated, which may take time. Remarkably, one antigen test for POCT of COVID-19 received an EUA within 2 months of the FDA policy to accelerate the development of diagnostic assay, and subsequently, several others have received an authorization (Table 50.2). Using an immunofluorescent assay method, the authorized test detects the presence of viral nucleocapsid particles, thus like molecular tests this test and other antigen tests would be useful for detecting new cases of COVID-19. Despite their promise for detecting new cases of COVID-19, historically the sensitivity of rapid antigen tests for the diagnosis of other respiratory viruses is often low. For example, the sensitivity of such tests for the pandemic swine influenza A/H1N1 were low to moderate (38%–53%) (Vasoo, et al., 2009). Thus, should antigen tests ultimately be marketed, they will likely augment molecular tests by serving as a test that can be rapidly deployed, but if negative, they will require confirmatory testing to rule out the presence of active infection.

Serological methods for POCT of COVID-19 are in various phases of development. These tests use enzyme-

**TABLE 50.2** Point-of-care tests for SARS-CoV-2 that have received an Emergency Use Waiver (EAU).

| Test  | Manufacturer                         | Date of EAU (2020) | Method                                | SARS-CoV-2 Analyte  | Specimen type | Prep time (mins) | Time to result (mins) | Capacity (cartridge or cassettes per run) | Performance N; (% Agreement) [95% CI] <sup>1</sup>  |
|---|--------------------------------------|--------------------|---------------------------------------|---|---------------|------------------|-----------------------|---|---|
| <b>Molecular Tests</b>  |                                      |                    |                                       |   |               |                  |                       |   |   |
| Xpert Xpress SARS-CoV-2 Test <sup>a</sup>                       | Cepheid                              | 03/20              | RT-PCR                                | SARS-CoV-2 nucleic acids for the N2 and E genes                         | NPS, NA       | 5                | 45–60                 | 2–4                                       | 20; 2 × LoD (100%) [83.9%–100%]<br>5; 3 × LoD (100%)*<br>5; 5 × LoD (100%)*<br>35; Negative (100%) [90.1%–100%]<br>90; PPA 97.8% [88.4–99.6%]<br>NPA 95.6% [85.2–98.8%] |
| Accula SARS-Cov-2 Test <sup>b</sup>                             | Mesa Biotech Inc.                    | 03/23              | Lateral Flow RT-PCR                   | SARS-CoV-2 nucleic acids for the N gene                                 | NTS           | 5                | 30                    | 1   | 50; PPA 95.8% [78.9–99.9%]<br>NPA 100% [86.8–100%]<br>OPA 98% [89.4–99.9%]  |
| ID NOW COVID-19 <sup>c</sup>                                    | Abbott Diagnostics Scarborough, Inc. | 03/27              | Isothermal nucleic acid amplification | SARS-CoV-2 RdRp gene  | NS, NPS, TS   | 1–2              | 5–13                  | 1   | 20; 2 × LoD (100%) [83.9%–100%]<br>10; 5 × LoD (100%) [72.3%–100%]<br>30; Negative (100%) [88.7%–100%]  |
| Cue COVID-19 Test <sup>d</sup>                                  | Cue Health Inc.                      | 06/10              | Isothermal nucleic acid amplification | SARS-CoV-2 nucleic acids for the N gene                                 | NS            | 5                | 20                    | 1   | 20; 1–2 × LoD (95%)*<br>4; 5 × LoD (100%)*<br>4; 10 × LoD (100%)*<br>2; 50 × LoD (100%)*<br>30; Negative (100%)   |
| Cobas SARS-COV-2 & Influenza A/B Nucleic Acid Test <sup>e</sup> | Roche Molecular Systems, Inc.        | 09/14              | RT-PCR, Multianalyte                  | SARS-CoV-2 nucleic acids for the N gene, IFV A matrix gene, & NSP IFV B | NS, NPS       | 5                | 20                    | 1-225 depending on analyzer               | SARS-COV-2 PPA: 229; PPA 100% [93.6–100%]<br>NPA 100% [98.4–100%]   |
| <b>Antigen Tests</b>  |                                      |                    |                                       |   |               |                  |                       |   |   |
| Sofia 2 SARS Antigen FIA <sup>f</sup>                           | Quidel Corporation                   | 05/08              | Lateral Flow IFA                      | SARS-CoV-2 N protein antigen  | NS, NPS       | 1–2              | 15                    | 1   | 20; 1 × LoD (100%)<br>10; 5 × LoD (100%)<br>PPA: 30; (100%) [88.6%–99.4%]<br>NPA: 47; (100%) [92.4%–100%]   |

(Continued)

**TABLE 50.2 (Continued)**

| Test   | Manufacturer                         | Date of EAU (2020) | Method                              | SARS-CoV-2 Analyte           | Specimen type | Prep time (mins) | Time to result (mins) | Capacity (cartridge or cassettes per run) | Performance N; (% Agreement) [95% CI] <sup>1</sup>   |
|--|--------------------------------------|--------------------|-------------------------------------|------------------------------|---------------|------------------|-----------------------|---|--|
| BD Veritor System for Rapid Detection of SARS-CoV-2 <sup>5</sup> | Becton, Dickinson and Company        | 07/02              | Chromatographic Digital Immunoassay | SARS-CoV-2 N protein antigen | NS            | 1                | 15                    | 1   | 226; PPA 84% [61–93%]<br>NPA 100% [98–100%]<br>OPA 98%<br>PPV 100%<br>NPV 97.5%              |
| LumiraDx SARS-CoV-2 Ag Test <sup>h</sup>                         | LumiraDx UK Ltd.                     | 08/18              | Microfluidic IFA                    | SARS-CoV-2 N protein antigen | NS            | 1                | 12                    | 1   | 257; PPA 97.6% [91.6–99.3%]<br>NPA 96.6% [92.7–98.4%]<br>OPA 96.9%<br>PPV 93.1%<br>NPV 98.8% |
| BinaxNOW COVID-19 Ag Card <sup>l</sup>                           | Abbott Diagnostics Scarborough, Inc. | 08/26              | Antigen/ Lateral Flow ICM assay     | SARS-CoV-2 N protein antigen | NS            | 1–2              | 15                    | 1   | PPA: 97.1% [85.1–99.9%]<br>NPA: 98.5% [92–100%]  |

*E gene*, gene that codes for the envelope that surrounds the SAR-CoV2; *ICM*, immunochromatographic; *IFA*, immunofluorescent assay; *IVF*, Influenza virus; *LoD*, Limit of detection; *N*, nucleocapsid; *N2*, one of three regions of the N nucleocapsid gene; *NA*, Nasal aspirate; *NPS*, Nasopharyngeal swab; *NS*, Nasal swab; *NTS*, Combined Nasal & Throat Swab; *NW*, Nasal wash; *NPA*, Negative Percent Agreement; *NPV*, Negative Predictive Value; *OPA*, Overall Percent Agreement; *PPA*, Positive Percent Agreement; *PPV*, Positive Predictive Agreement; *RdRp gene*, RNA-dependent RNA polymerase gene; *TS*, Throat Swab.

\*95% C.I. not provided, or not calculated due to sample size; <sup>1</sup>LoD determined from contrived specimens.

<sup>a</sup>Xpert Xpress-CoV-2 EUA Package Insert (Xpress System), Document number: 302-3750 Rev. D (August 2020), Cepheid. <https://www.cephheid.com/Package%20Insert%20Files/Xpress-SARS-CoV-2-PI/302-3750%20rev%20C%20PACKAGE%20INSERT%20EUA%20XPRESS%20SARS-COV2.pdf> (Accessed 16 September 2020).

<sup>b</sup>Accula SARS-CoV-2 Test Instructions for Use Document, 60061-1(2020-08) Accula SARS-CoV-2IFU, Mesa Biotech, Inc. <https://static1.squarespace.com/static/5ca44a0a7eb88c46af449a53/t/5e8d218517114d6ea7f60dc2/1586307464282/60061+Rev+1+Accula+SARS-CoV-2+IFU.pdf> (Accessed 16 September 2020).

<sup>c</sup>ID NOW COVID-19 Package Insert, IN190000 Rev.4 2020/05, Abbott Diagnostics Scarborough, Inc. <https://www.alere.com/en/home/product-details/id-now-covid-19.html> (Accessed 16 September 2020).

<sup>d</sup>Cue™ COVID-19 Test Instructions For Use Document C1018, Cue Health Inc. <https://www.fda.gov/media/138826/download> and <https://www.cuehealth.com/covid-19> (Accessed 16 September 2020).

<sup>e</sup>Cobas SARS-COV-2 & Influenza A/B Nucleic Acid Test Package Insert 09216235001-01EN Doc Rev. 1.0 Roche Molecular Systems, Inc. <https://www.fda.gov/media/142193/download> (Accessed 16 September 2020).

<sup>f</sup>SOPIA 2 SARS Antigen FIA Package Insert. 20374 – Sofia 2 SARS Antigen FIA – 25 Test, 1438900EN00 (05/20), Quidel Corporation. [https://www.quidel.com/sites/default/files/product/documents/EF1438900EN00\\_0.pdf](https://www.quidel.com/sites/default/files/product/documents/EF1438900EN00_0.pdf) (Accessed 9 May 2020).

<sup>g</sup>BD Veritor System for Rapid Detection of SARS-CoV-2 Package Insert 500048916(02) 2020-08 Becton, Dickinson and Company <https://www.fda.gov/media/139755/download> (Accessed 16 September 2020).

<sup>h</sup>LumiraDx SARS-CoV-2 Ag Test Package Insert. SPEC-32311 R1 ART-00570 R1 Date of Revision 2020/08 LumiraDx UK Ltd <https://www.lumiradx.com/us-en/> (Accessed 16 September 2020).

<sup>l</sup>BinaxNOWTM COVID-19 Ag CARD Package Insert IN195000 Rev.1 2020/08 Abbott Diagnostics Scarborough, Inc. <https://www.globalpointofcare.abbott/en/product-details/navica-binaxnow-covid-19-us.html> (Accessed 16 September 2020).

linked immunosorbent assays (ELISA) to detect the presence of IgM or IgG antibodies directed against the virus in a whole blood, plasma, or serum sample. When marketed, an antibody test that can be performed in a patient-care setting should be easy to perform. Performing POCT using such tests will involve applying a small sample of blood from a finger stick (i.e., drops) onto a cartridge containing the immunoassay, followed by a couple of drops of a buffer solution. The qualitative results should then be displayed within minutes. The initial antibody response to an infection comprises IgM antibodies, followed in time, by IgG antibodies. Thus the detection of IgM antibodies by a test result would be indicative of recently acquired COVID-19 infection, whereas detecting IgG antibodies would signify that some time had elapsed since acquisition of infection. Antibodies to SARS-CoV-2 are produced over days to weeks after infection and data suggest that patients develop antibody response in the second week after onset of symptoms [World Health Organization (WHO), 2020c]. Thus, such tests will not be useful for detecting active infection but rather will likely be most useful approximately 10–14 days after infection in patients who are asymptomatic (e.g., symptoms resolved or never manifested). Once validated serologic methods for POCT of COVID-19 are marketed, they will be used in disease surveillance and epidemiology efforts to determine population immunity.

### 50.6.3 Expanding the pharmacist's ability to test for COVID-19

Shortly after the FDA accelerated the path for COVID-19 POCT to market, HHS issued a policy permitting licensed pharmacists to order and administer FDA-authorized COVID-19 tests [Health and Human Services (HHS), 2020]. This policy extended legal protections under the Public Readiness and Emergency Preparedness (PREP) Act to pharmacists [Health and Human Services (HHS), 2020]. As “covered persons” under the PREP Act, pharmacists can collect nasopharyngeal, throat, or nasal swabs from patients with suspected COVID-19 infection and perform POCT using assays that have EUA. In addition, the policy allows pharmacists to perform FDA-authorized serological tests for COVID-19. However, unless the FDA policy changes, if a COVID-19 serology test comes to market under an EUA lacking a CLIA classification, and an EUA, it will be considered a high-complexity test and not allowed to be performed outside of an appropriately CLIA-certified laboratory (Gibbs et al., 2020). When HHS issued the policy, the only serological test for COVID-19 on the market had EUA, but its use was limited to laboratories CLIA-certified to perform moderate and high-complexity tests. The lack of serological tests that are granted EUA and waived may limit pharmacists’

POCT efforts for COVID-19 to testing patients for active infection using molecular or antigen-based tests. In addition to the federal agencies and laws regulating and governing the provision of diagnostic tests, pharmacists should be aware of local and state agencies and statutes that determine their ability to order and administer tests for COVID-19.

### 50.6.4 Pharmacists' role in point-of-care testing for COVID-19

Effective mitigation of the COVID-19 pandemic requires high-throughput diagnostic testing, case isolation and contact tracing, and the deployment of therapies to prevent and treat infection. As a vital member of the healthcare team, pharmacists are well positioned to aid in diagnostic testing and deployment of therapies for prevention and treatment of infection. Pharmacists are highly trained and trusted healthcare professionals with established relationships with their patients, providers, and other healthcare personnel. Community pharmacies are the most accessible healthcare facilities, far more numerous than other healthcare facilities, including hospitals and community-based clinics. Moreover, most Americans live in close proximity to a pharmacy. All these characteristics make pharmacists a critical component to expanding COVID-19 testing capacity to a level needed to mitigate the pandemic.

**Government:** In the early stages of the COVID-19 pandemic, public health laboratories were the only laboratories authorized to conduct testing outside of the CDC. While pharmacists can perform POCT in their pharmacies, if such tests are not readily available, they can also support government efforts to test for COVID-19 by communicating with local and state public health staff to determine which persons meet the criteria for testing. Pharmacists or their staff, once professionally trained, can collect specimens and follow state and local health departments’ guidance on proper specimen storage and shipping procedures and any documentation that may be required.

**Health systems:** Many health systems have centralized laboratory services that process and analyze diagnostic specimens, or they have contractual relationships with private or commercial laboratories to conduct certain tests offsite. Therefore it is unlikely pharmacists in health systems would administer tests for COVID-19, but they could order such tests for their patients if they were allowed to do so by institution policies and if the test had an EUA.

**Community:** The role of pharmacists in government and health-system testing centers for COVID-19 is still evolving. However, pharmacists in the community setting will be part of a team of healthcare professionals and will likely share testing responsibilities with other healthcare providers. Community pharmacies in collaboration with federal, health agencies, state and local authorities leveraged the

accessibility of their facilities to expand drive-through testing sites nationwide. These sites, overseen by pharmacists, will offer molecular and antigen testing, and perhaps serological tests, if waived, when they are marketed.

A practice model for pharmacists to perform POCT for a seasonal respiratory virus capable of causing a pandemic already exists with CLIA-waived POCT (CLIA-POCT) for influenza A/B using antigen and molecular methods (Klepser et al., 2018, 2019). In that model, community pharmacists work under a collaborative practice agreement (CPA) and perform basic physical assessment and diagnostic CLIA-POCT for influenza A/B. If allowed by the CPA, based upon the findings from the patient assessment and the CLIA-POCT result, pharmacist can administer immunization, initiate antiviral therapy, or recommend self-care products for symptomatic relief (Klepser et al., 2018, 2019). Such a practice model is used to provide appropriate treatment to patients with and without influenza A/B. Although a vaccine to prevent and therapies to treat COVID-19 do not yet exist, other aspects of the practice model can be implemented, particularly in low-risk patients who are experiencing mild symptoms. In many instances, this collaborative model spares low-risk patients the need for a provider's office visit (Klepser et al., 2018, 2019).

Performing CLIA-POCT services for COVID-19 represents an opportunity for pharmacists, public health professionals, and prescribers to collaboratively address a significant infectious disease public health threat in their community (Gubbins et al., 2017). Such services create an opportunity for information sharing between pharmacies and public health agencies. Information regarding immunizations administered, pharmacy-based POCT for COVID-19 results, and surges in purchases of over-the-counter medications for relief of symptoms associated with viral respiratory tract infections can inform future COVID-19 public health surveillance efforts (Gubbins et al., 2017; Rubin et al., 2014).

### 50.6.5 Essential PPE for COVID-19 point-of-care testing

As part of creating a COVID-19 testing center, pharmacies and pharmacists should follow the CDC's recommendations on proper hand hygiene and recommended PPE to reduce the spread of SARS-CoV-2 [Centers for Disease Control and Prevention (CDC), 2020h]. Pharmacists conducting COVID-19 POCT should perform proper hand hygiene and wear appropriate PPE when in close quarters with potentially infectious patients and collecting and handling specimens. The CDC created a "Burn Rate Calculator" to assist facilities in estimating the length of current PPE supply and assist with projecting future needs. The calculator can be found at <https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/burn-calculator.html>.

Prior to putting on and after removing PPE, pharmacists should perform hand hygiene by using alcohol-based hand sanitizer or washing with soap and warm water for 20 seconds or more. In addition, pharmacists should perform hand hygiene before and after any patient contact, and after handling potentially infectious materials. Prior to entering a patient-care area, pharmacists should collect and don appropriate PPE to limit the transmission of SARS-CoV-2. Appropriate PPE include isolation gown, respirator (or facemask if a respirator is not available), eye protection, and gloves. N95 respirators (or other available high-level respirators) are preferred in known or suspected COVID-19 situations. A surgical facemask is acceptable if a respirator is not available. Cloth face coverings are not considered as adequate PPE and should not be used when coming in close contact with known or suspected COVID-19 cases. Eye protection in the form of goggles or face shield covering the front and sides of the face should be worn to limit exposure. Eyeglasses or contact lenses are not considered as adequate PPE and appropriate PPE should be worn over these.

With PPE in short supply, extended use, reuse, and PPE optimization measures must be considered. When reusing PPE, follow the manufacturer's reprocessing instructions for guidance on cleaning and disinfecting PPE. More information on extended use and how to optimize PPE supply is available at <https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/index.html>.

## 50.7 Pharmacists' response in critical care and healthcare systems

Hospitals in regions significantly impacted by SARS-CoV-2 have seen an unprecedented surge in critically ill patients with COVID-19 requiring prolonged courses of mechanical ventilation (average of 15–20 days) and other supportive care interventions (Zagury-Orly and Schwartzstein, 2020). In response to this surge, institutions doubled or tripled their intensive care unit (ICU) capacity in a matter of weeks, forcing conversion of various areas of the hospital into makeshift critical care units, cross-training noncritical care staff, and redefining many aspects of pharmacy services. These challenges place clinical pharmacists (especially those with training in critical care, emergency medicine, and infectious diseases) in a unique position to have significant impact in mounting a response to the pandemic.

Critical care pharmacists play an integral role in the care of intensive care patients. Clinical responsibilities typically include interdisciplinary rounding, providing pharmacotherapeutic recommendations, various aspects of antimicrobial, opioid, and anticoagulation stewardship, patient monitoring, protocol development, and responding to medical emergencies. Operational responsibilities typically include hospital committee participation, such as



pharmacy and therapeutic committee; medication safety committee; and institutional review boards; drug distribution; staff education (pharmacists, nurses, and physicians); and maintenance of intravenous (IV) pump libraries and electronic medical record systems. The presence of a critical care pharmacist in hospitals through the application of best practice guidelines has been shown to reduce ICU length of stay, duration of mechanical ventilation, and mortality (Netzer et al., 2011).

### 50.7.1 Overview of intensive care and clinical pharmacy services

This section will provide a detailed overview of typical critical care pharmacy operations and the changes that were implemented in response to challenges from COVID-19. Intensive care services are typically reserved for patients who currently have or are at a high risk of developing acute end organ failure. It is essential to triage patients to ensure that this limited resource is reserved for patients who are likely to benefit from ICU care, essentially for those patients who are not “too well” or “too sick” to benefit. Depending on the region and types of services offered, many hospitals have at least one ICU with anywhere from 6 to 30 beds and some hospitals have multiple ICUs reserved for specific types of patients—medical, cardiac, pediatric, neonatal, neurologic, and others. Typically, critical care pharmacists will round in one or two of these units with oversight of the pharmacotherapy for these patients.

The most common reason patients require ICU-level care due to COVID-19 is acute hypoxic respiratory failure requiring the support of mechanical ventilation or other noninvasive forms of ventilatory support such as bilevel positive airway pressure (BIPAP) or continuous positive airway pressure (CPAP). These patients have severe oxygenation issues and often meet criteria for a condition known as acute respiratory distress system (Bhatraju et al, 2020). Other complications seen in these patients are electrolyte abnormalities, acute kidney injury, shock, coagulopathies, (including thrombosis), and cardiac complications (Alhazzani, 2020). Prolonged courses of mechanical ventilation and administration of drugs required for ventilatory and hemodynamic support such as sedatives, analgesics, paralytics, and vasopressors further complicate the management of these patients.

### 50.7.2 Impact of COVID-19 on hospitals and critical care

A trend across the US and other countries was observed in which there was significant decrease in patients presenting to the hospital with critical conditions such as stroke, acute coronary syndrome, and septic shock. In place of these

patients presenting to the hospital, there was a high influx of COVID-19-infected patients requiring critical care services that led to significant shortage of resources such as ICU beds, staff, PPE, ventilators, and medications.

#### 50.7.2.1 PPE shortages

There were unprecedented shortages in PPE—surgical gowns, surgical masks, N95 masks, gloves (sterile and nonsterile), hair nets, shoe covers, face shields, drapes, and many others. The causes of the PPE shortages are similar in nature to the drug shortage causes listed next (production issues, increased demand, and hoarding).

#### 50.7.2.2 Drug shortages

The international medication shortages caused by COVID-19 were unparalleled and significantly impacted hospital operations and provision of best practices for pharmacotherapy. These new drug shortages placed a significant burden on an already strained drug supply chain. In response to this, Congress initiated bill H.R.6080—Preventing Drug Shortages Act of 2020. A section on drug shortage mitigation is included in [section 50.7.6](#) and [50.7.7](#). The causes of these drug shortages were multifactorial and are summarized next:

- *Production challenges*—The US drug supply chain is heavily dependent on active pharmaceutical ingredients and drug manufacturing in China and India, which had production issues directly associated with COVID-19 (Silverman (2020).
- *Hospital hoarding*—Many hospitals in the country quickly reacted to increase their inventories in anticipation for a patient surge, further worsening the shortages. This action resulted in major challenges for treating critically ill patients at hospitals in COVID-19 hotspots.
- *Increased demand*—Critically ill patients with COVID-19 were shown to have a prolonged clinical course. Many states implemented a hold on elective surgeries and medical procedures to help decrease some of the demand for PPE and medications used for these patients.

Many institutions were forced to implement a triaging system to prioritize those who would benefit from intensive care the most and many patients who normally would be managed in an ICU were placed in step-down units and other units serving as makeshift ICUs.

Beyond the application of fundamental critical care management principles to the care of these patients, significant changes to standard practices were needed to reduce healthcare personnel exposure, and to mitigate unprecedented shortages in PPE and medications. Creative ways pharmacists have done this are described in [Box 50.4](#).

**BOX 50.4 Pharmacist strategies for inpatient management**

- Block timing of medications—typically pharmacists stagger medication administration to allow nurses more time to administer them or to decrease patient burden. Instead drugs were administered as close together as possible to limit the need to go into and out of the patient rooms (e.g., all twice daily medications given at 0900/2100, whereas previously some may have also been given at 0900/1700).
- Moving to longer acting agents (e.g., metoprolol tartrate → metoprolol succinate).
- Promoting therapies that require less frequent monitoring (e.g., heparin → enoxaparin to reduce blood draws for PTT monitoring).
- Removal of therapies with little proven clinical benefit (e.g., multivitamins).

Due to the extreme limitation of medications and other resources, a shift occurred from optimizing individual patient care to global survivorship. This shift required implementation of ethics policies and decision-making to determine which patients would most benefit from receiving certain medications (Emanuel et al., 2020). The Italian Society of Anesthesia, Analgesia, Resuscitation, and Intensive Care (SIAARTI) issued clinical ethics recommendations for the allocation of intensive care treatments in exceptional, resource-limited circumstances. These guidelines outline considerations for patient selection based on factors such as age, comorbidities, functional status, ICU admission criteria, and decisions to limit care (Riccioni et al., 2020).

Clinical pharmacists play a key role in disaster medicine responses as members of the interdisciplinary team and contribute to the ethical decision-making processes. There were many ethical deliberations surrounding pharmacotherapy decisions that were made during the pandemic and are summarized in Table 50.3. These decisions were made using an interdisciplinary approach and required constant patient reassessment for the likelihood of survival, staying up to date with the rapidly changing medical literature, and extensive work to secure drug supply (Emanuel et al., 2020).

### 50.7.3 Ensuring best practices in providing evidence-based medicine

This highly contagious pandemic in an era of social media created an unprecedented need to practice evidence-based medicine. Never in modern medicine has the importance of “first do no harm” been as important. The rapid spread of the disease, high morbidity, and mortality rates made healthcare workers desperate to come up with a solution to help save these patients. A credible anecdotal report or a simple suggestion on social media could spur development of a hospital policy or protocol during this pandemic.

The COVID-19 pandemic created a period of uncertainty for drug therapy. Several questions raised in the intensive care setting include:

- What are the potential treatments for COVID-19?
- What are the best practices for supportive care in these patients?
- What is the effect of SARS-COV-2 on organ function?
- What clinical trials are available for COVID-19 patients?

At the time of writing this chapter, there had been no results from randomized control trials supporting any specific treatment for COVID-19. Treatments touted for COVID-19 were based on low-quality evidence from nonrandomized, noncontrolled trials, expert opinion, anecdotal reports, and experience from other severe viral outbreaks (SARS, MERS, and Ebola) (Table 50.4). This desperation mixed with medical information flowing at a rapid rate through the news and social media outlets led to significant increases in off-label use of medications and use of therapies with unknown benefits and risks in these vulnerable patients.

The use of these agents would not typically meet the minimum evidence threshold to be considered as potential therapies. However, the COVID-19 pandemic caused a period of unrest and desperation to improve ICU survival, creating pressure at all levels to attempt several dubious treatments. Many clinical societies and government agencies acted quickly to increase drug supply and clinical treatment options for these patients through an FDA Emergency Use Authorization, and FDA-approved Expanded Access Program.

There are currently at least 25 drugs under investigation for use in COVID-19 and 10 are actively in clinical trials (Rome and Avorn, 2020). Best practices in the application of evidence-based medicine call for rigorous premarketing evaluation of a drug’s safety and effectiveness in randomized, controlled trials. Straying from these principles places the public at considerable risk for receiving drugs that are ineffective, unsafe, or both (Table 50.4).

One of the most crucial roles that pharmacists played during the pandemic is to ensure rational, safe, and judicious use of drug therapy with limited evidence available. This role was accomplished through standardizing COVID-19 therapy in protocols, staying current with the

**TABLE 50.3** Examples of ethical considerations made in the provision of pharmacotherapy during COVID-19.

| Ethical considerations  | Clinical issues  | Decisions made  |
|---|--|---|
| <p>Prioritizing healthcare resources (drugs, supplies, and interventions) for patients based on prognosis and overall life expectancy</p> | <ul style="list-style-type: none"> <li>• Major shortage of CVVH solutions, dialysis machines, and limited staff available to perform intermittent hemodialysis</li> <li>• Frequent deaths occurring from cardiac arrest (Code Blue); Advanced Cardiac Life Support (ACLS) hindered by limited staff and inadequate PPE</li> </ul>  | <ul style="list-style-type: none"> <li>• Discontinuing hydroxychloroquine in patients once mechanically ventilated.</li> <li>• Discontinuing Remdesvir in patients with acute end organ dysfunction.</li> <li>• Reserving shorter acting and “preferred” IV sedatives and analgesics for patients likely to be extubated and using longer acting IV or enteral medications for patients with a poor prognosis.</li> <li>• Prioritizing CVVH machines for patients most likely to benefit from therapy (withdraw therapy from patients with poor prognosis).</li> <li>• Prospective conversations with families to establish code status to DNR for patients with poor prognosis</li> <li>• Updated ACLS guidelines published emphasizing ethical considerations.</li> </ul> |
| <p>Use of supportive care agents or alternative dosing strategies with unknown risk to benefit ratios</p>                                 | <ul style="list-style-type: none"> <li>• Case series indicating higher than normal rates of venous thromboembolism in SARS-COV-2 patients.</li> <li>• Rapidly emerging nonexperimental research on off-label or investigational drug therapy for SARS-COV-2 viral infection based on case series and nonrandomized studies.</li> </ul>   | <ul style="list-style-type: none"> <li>• Hospitals developed protocols utilizing inconclusive evidence on anti-infective drugs, anticoagulants, and thrombolytics, as well as clinical indicators for therapy (i.e., laboratory value thresholds).</li> <li>• Rapid revisions of protocols in response to emerging case reports (case reports of cardiac toxicities with combination therapy led to recommendations against use by various agency guidelines).</li> </ul>   |
| <p>Balancing resource limitations, healthcare exposure, and patient outcomes</p>  | <ul style="list-style-type: none"> <li>• Prone ventilation—a procedure that has shown benefit in improving oxygenation in patients with ARDS, is labor-intensive, requires heavy PPE consumption, and increases healthcare worker exposure.</li> <li>• Aerosolizing procedures such as administration of medications via nebulization increase exposure to SARS-COV-2. This caused a shortage in MDIs and hospitals had to choose between increasing exposure via nebulization or reusing MDIs in patients.</li> </ul> | <ul style="list-style-type: none"> <li>• Health systems balancing if the risk of increased employee exposure and consumption of PPE (takes up to five employees to put the patients in the prone position) outweighed the potential benefits to the patients. Prone positioning was prioritized for patients who were determined to have a better prognosis.</li> <li>• MDI shortages managed by using a “common canister” procedure that requires extensive education and infection control processes (ISMP, 2020).</li> </ul>   |
| <p>Cost mitigation in a mass casualty situation</p>   | <ul style="list-style-type: none"> <li>• Use of costly immunomodulators such as IL-6 inhibitors proposed to prevent cytokine storm and complications of SARS-COV-2.</li> <li>• Immunomodulators lack proven benefit in SARS-COV-2 and are associated with serious adverse reactions.</li> <li>• These agents add additional significant financial strain to institutions. Most hospitals have limited testing capacity to determine which patients would most benefit from the medication.</li> </ul>                  | <ul style="list-style-type: none"> <li>• Health systems developed unsupported criteria of use and assigned expert prescribers as gatekeepers to approve the use of the agent in patients who were deemed most likely to benefit from therapy.</li> </ul>  |
| <p>Complying with regulations while meeting an increased demand</p>   | <ul style="list-style-type: none"> <li>• Mass shortages of drugs were happening in impacted areas meanwhile there was adequate supply in other parts of the country.</li> <li>• Strict compounding guidelines and pharmacy practice regulations resulted in significant increases in pharmacy workload and drug waste.</li> </ul>  | <ul style="list-style-type: none"> <li>• Health systems requesting waivers to state regulations to ship medications to other hospitals and systems across state lines.</li> <li>• Pharmacists tasked with assigning reasonable BUDs for drugs based on limited data to counter catastrophic supply chain disruption.</li> </ul>   |

ARDS, Acute respiratory distress syndrome; BUDs, beyond-use dates; CVVH, continuous veno-venous hemofiltration; SARS, severe acute respiratory syndrome; DNR, do not resuscitate; IV, intravenous; MDIs, metered dose inhalers.

**TABLE 50.4** Examples of utilized COVID-19 treatments and level of evidence.

| Medication          | Highest level of evidence for SARS-COV-2 | Notable toxicities                                  |
|---------------------|--|---|
| Hydroxychloroquine  | Retrospective analysis                   | QTc prolongation <sup>a</sup>                       |
| Lopinavir/ritonavir | Retrospective analysis                   | Skin rash, hypertriglyceridemia <sup>a</sup>        |
| Ivermectin          | In vitro                                 | Mazzotti reactions <sup>b</sup>                     |
| Tocilizumab         | Case series                              | Opportunistic infections <sup>c</sup>               |
| Remdesivir          | Ongoing clinical trials                  | Acute kidney injury <sup>d</sup>                    |
| Statins             | Anecdotal                                | Transaminitis <sup>e</sup>                          |
| Immune globulin     | Case series                              | Thrombosis, infusion-related reactions <sup>f</sup> |

SARS, Sudden acute respiratory syndrome.

<sup>a</sup>Bhimraj et al. (2020).

<sup>b</sup>Kerneuzet et al. (2018).

<sup>c</sup>Pawar et al. (2019).

<sup>d</sup>Grein et al. (2020).

<sup>e</sup>Calderon et al. (2010).

<sup>f</sup>Alhazzani et al. (2020).

available literature, promoting use of therapies with the best evidence, and prioritizing drug safety.

Several challenges arose which include:

- Prioritizing therapies with little efficacy data
- Updating guidelines with rapidly changing literature
- Updating stakeholders with new recommendations
- Rapid education and implementation into policies, procedures, order sets, and electronic medical record systems

This pandemic has taught us that our patients are best served by sticking to principles of evidence-based medicine and establishing mechanisms to rapidly implement change as the evidence becomes available rather than have knee-jerk reactions to anecdotal reports and media.

#### 50.7.4 Hospital code team responses (stroke, cardiac arrest, sepsis, and rapid responses)

Many hospitals have various rapid response and code teams to quickly address the needs of patients experiencing medical emergencies and to ensure best practices with medical management. These codes often happen in critically ill or rapidly decompensating patients and it is essential that care is provided in a fast and safe manner. Code response teams vary by the type of medical emergency but generally consist of one to two designated physicians, several nurses, a pharmacist, respiratory therapist, and others as needed. The rooms can become crowded with all the members of the response team—this type of code response results in a huge burden on PPE consumption (see [Section 50.7.6](#), [50.7.7](#)).

Code carts contain a large supply of medications and supplies and are usually brought into the patient's room to allow for quick and easy access to everything that can be

needed to efficiently manage the code. At the conclusion of the code, the cart is brought to a central processing area for cleaning and decontamination. Used medications trays are exchanged for replacement trays by the pharmacy team.

Pharmacists play a key role as members of the code committee and a summary of responsibilities is outlined in [Box 50.5](#).

#### 50.7.5 Pharmacy staffing models in response to COVID-19 and impact on pharmacy code response

COVID-19 caused many hospitals to change their schedules and staffing structures to address large increases in patient volumes and to prevent pharmacy departments from getting sick or exposed to COVID-19. Best practices for limiting the spread of COVID-19 initially was a 14-day self-quarantine after exposure, even for people without symptoms. Given the relatively small size of a pharmacy team, an entire pharmacy department could potentially be impacted if a single team member became ill and encountered other staff ([Arons et al., 2020](#)). To mitigate this risk, hospital pharmacy teams implemented social distancing, switched to block scheduling, restructured operational and clinical responsibilities, and centralized pharmacy staff. In this case the ethical decision was made to operate the pharmacies at a reduced scope of practice to preserve the overall workforce for as long as possible and prevent major disruptions in drug supply services.

Block schedules help to prevent the entire pharmacy department from getting sick by reducing employee

**BOX 50.5 Guideline compliance**

- Guideline compliance and ensuring best practices for pharmacotherapy (e.g., door-to-needle times for stroke, antibiotic administration for sepsis, and medication preparation for ACLS)
- Provision of drug information and enhanced medication safety—allergies, dosing, drug selection, drug interactions, and medication histories
- Medication administration if approved by hospital policies and provision of ACLS (e.g., compressions or managing the defibrillator)
- Expediting medication administration
  - Compounding at the location of the code or, if needed, expediting the compounding and delivery from the main pharmacy
- Managing the code cart (handing out supplies, priming IV bags)
- Assisting with rapid sequence intubation—preparing medications and providing dosing recommendations

**BOX 50.6 Aerosolizing procedures**

- Endotracheal intubation
- Noninvasive ventilation (CPAP and BIPAP)
- Airway suctioning
- High-flow oxygen therapy
- Medication administration via nebulization (if not in a closed ventilator circuit)

cross contamination. It involves creating separate pharmacy teams that do not interact with each other to reduce potential virus spread. To accommodate block scheduling and meet the overall needs of the hospital, many pharmacists who were normally decentralized on the hospital floors, providing dedicated clinical services (e.g., critical care pharmacists), and responding to codes had to revise their workflows and responsibilities. Such modifications included an increased emphasis on general medication management and drug distribution services such as IV compounding and medication delivery and a decreased emphasis on some of the clinical functions such as stewardship, therapeutic optimization, or patient rounding.

Given the high severity of illness, high mortality, and reduced staffing models—pharmacy teams also had to modify their code response criteria. For example, during a code stroke, a pharmacist may typically go to the code and assist with patient screening for appropriateness of thrombolytic administration, mixing the medication, helping the nurse set up the IV pump, and other responsibilities. In a modified code response the pharmacist may call the area with the code stroke to see if any assistance is needed and to centralize responsibilities, such as medication preparation.

The most significant impact on code response and medication management was with pharmacy response to Code Blue and Rapid Response Team activation. SARS-COV-2 is transmitted through respiratory droplets and the risk is highest while performing aerosolizing

procedures that are often interventions provided during Code Blue and Rapid Responses. [Box 50.6](#) lists interventions associated with generation of aerosolizing respiratory droplets.

There is evidence to show that SARS-COV-2 is viable on surfaces (plastics, metals, papers) and in the air from 3 to 72 hours ([van Doremalen et al., 2020](#)). This finding created a significant challenge with standard code management in many ways. Hospitals were overwhelmed with the volume of codes that were occurring and decontamination processes are very time-consuming especially with limited staff. Many hospitals did not have designated COVID-19 units or testing was unavailable. Transporting code carts, supplies, and medications that were exposed to a procedure promoting aerosolization of virus particles places other healthcare workers and employees at risk. Scientists lacked a clear understanding of how the virus was transmitted and what was considered a meaningful clinical exposure, which led to a huge amount of drug, supply, and equipment waste.

Code carts often contain over 20 different medications (in large quantities) but many are rarely used. Discarding large quantities of unused medications significantly increased the burden of drug shortages that hospitals were already struggling with (see drug and PPE shortage section).

Pharmacists who responded to codes had to shift their workflow and priorities in response to these challenges. The primary focus became drug conservation—preventing drug and supply waste by keeping as much as possible outside of the patient room. Smaller medication kits were created (instead of the large trays of 20+ drugs) with



limited quantities of commonly used medications to be brought into the patient's room. Medications were individually bagged to allow them to be cleaned and transferred into other bags. In the event that drug vials or other dosage forms were accidentally exposed during a code, they were cleaned with isopropyl alcohol, sequestered in a hard-plastic tote for as long as possible (ideally over 10 days based on the surface viability of SARS-COV-2) and cleaned a second time before being returned to general circulation.

Modified code responses were implemented due to severe PPE shortages and best practices for infection prevention. This modification included reducing the number of people entering the patient's room as much as possible. Pharmacists who typically enter the room during the code transitioned to stay outside of the room and continued to perform responsibilities such as medication preparation and compounding, time keeping, provision of drug information and clinical resources, and reviewing patient history/labs/medications.

### 50.7.6 Drug shortage mitigation—purchasing considerations

Most hospitals belong to group purchasing organizations (GPOs) that assist with drug purchasing strategies, clinical strategies, and contracting. Typically, GPOs are contracted with preferred drug wholesalers that are the primary source for obtaining more than 95% of the drugs used by the hospital (by volume). The remaining 5% of drug purchases are made up by 503B (compounding) vendors, specialty vendors (especially if the hospital has a lot of outpatient services), and manufacturer direct purchases.

As mentioned previously, to combat the hoarding and increased demand, many wholesalers implemented allocations based on historic purchases—meaning you can only buy an amount of a drug that is consistent with an institution's average monthly utilization. If a hospital has a large increase in critically ill patients, and those patients have an increased length of stay and higher medication consumption rates, then those historic allocations were not sufficient to meet patient needs. Hospitals in this situation had to resort to paying higher costs for medications from non-contracted sources, increase direct purchases from manufacturers when available, increase 503B vendor utilization, secondary distributors, and, in some cases, gray market vendors.

There have been case reports of hospitals purchasing counterfeit PPE (N95 masks) as well as attempts made by non-FDA vendors from overseas attempting to sell medications in the US and take advantage of the situation. This development has shown how essential it is to always

verify drug pedigree and quality to ensure patient safety despite increasing pressures from multiple stakeholders to guarantee and ensure drug supply.

Many states have removed or lightened restrictions on shipping medications across state lines and allowed for transfer of both controlled and noncontrolled substances between hospitals that are owned by the same legal entity (as long as appropriate drug record keeping is maintained). The removal of these restrictions eased shortage concerns in COVID-19 hotspots by allowing a redistribution of limited resources.

### 50.7.7 Drug shortage mitigation—compounding considerations

All compounded medications must be assigned a beyond-use date (BUD) in accordance with state board of pharmacy regulations. States follow US Pharmacopeia (USP) 795, 797, and 800 guideline recommendations for determining an appropriate BUD. The considerations for BUD typically include consideration for primary engineering controls such as the laminar airflow hood, secondary engineering controls such as an ISO-7 clean room, the number of components, and drug-specific stability and sterility considerations. Hospitals use segregated compounding areas for preparing IV drugs that typically grant immediate use or less than 12 hour BUD. The USP issued a temporary suspension of their guidelines to allow for an extended BUD to reduce unnecessary waste and to help ease pharmacy workload challenges. Acceptance of these reduced guidelines varied by state but was overall generally accepted.

There was also considerable impact of the PPE shortage on IV compounding workflows. Surgical masks, gowns, gloves, and other PPE were being prioritized for other frontline healthcare workers, so pharmacies were reusing surgical masks and made other efforts to reduce PPE consumption.

Propofol, primarily used for sedation during mechanical ventilation, had significant shortages due to decreased supply and increased demand. It is available in 20, 50, and 100 mL formulations and COVID-19 patients typically require approximately 300 mL per day for sedation. The IV tubing and bottle should be changed every 12 hours to decrease the risk of line infections. Many hospitals were only able to get 20 mL vials, which resulted in a huge burden for nurses due to the need for frequent bottle changes. Generally, propofol should not be manipulated as it can react with many of the components in IV bags, but the FDA issued a guidance document to support pooling propofol and assigning a short BUD of 6 hours [[Food and Drug Administration \(FDA\), 2020a](#)].

### 50.7.8 Summary of critical care pharmacy impact in COVID-19

Responding to an unknown, highly contagious infectious disease with significant morbidity and mortality presented significant challenges to standard hospital and pharmacy operations. All pharmacy team members played significant roles in mitigating the impact of the virus and ensuring continuity of pharmacy medication management services. Many pharmacists and other healthcare personnel without critical care experience were cross-trained to help address the surge in number of these critically ill patients.

Since there is no specific treatment for COVID-19, the therapeutic interventions are supportive in nature and boil down to fundamental critical care support. This situation placed critical care pharmacists in a unique position to help care for these patients through educating others, prioritizing resource allocation, and serving as liaison between teams in an environment where communication has never been more essential.

## 50.8 Pharmacists' response in long-term care settings

In the spring of 2020, people living in LTC were the segment of the population hardest hit by the COVID-19 pandemic. The [Centers for Disease Control and Prevention \(CDC\) \(2020i\)](#) identified a higher risk for “older adults and people of any age who have serious underlying medical conditions.” The combined factors of comorbidity, advanced age, and congregate living set the stage for tragedy. Before the alarm was raised, asymptomatic or minimally symptomatic visitors, families and staff traveled in and out of the buildings, potentially carrying the virus into the isolated communities and unwittingly increasing spread.

In February, 2020 the first outbreak was reported at a long-term residential care facility in King County, Washington, where 129 people (81 residents, 34 staff members, and 14 visitors) were infected ([McMichael et al., 2020](#)). The outbreak resulted in 23 deaths ([McMichael et al., 2020](#)). It was the first of many facilities in which the focus of pharmaceutical care rapidly changed from health maintenance to management of infectious disease. Care of the elderly and disabled can be challenging at the best of times. The introduction of contagious subacute progressive illness stretches staff and care resources in previously unanticipated ways. Initially, the integration of PPE into daily care was hampered by limited availability and necessary process changes. COVID-19 is especially virulent in patients greater than 85 years of age, with an estimated mortality rate of 10%–27% of confirmed cases [[Centers for Disease](#)

[Control and Prevention \(CDC\), 2020j](#)]. Pharmacists need to be prepared with medications for infectious disease treatment and end of life care.

Immediately following the initial outbreak, the American Society of Consultant Pharmacists launched a resource page and webinar series addressing the issues that would be affecting the practice of pharmacy in this setting [[American Society of Consultant Pharmacists \(ASCP\), 2020](#)]. CDC and CMS released guidance documents for facilities on infection control and preparedness [[Centers for Disease Control and Prevention \(CDC\), 2020k,2020l](#)]. State pharmacy associations, such as the New Jersey Pharmacists Association, began working with the local boards of pharmacy and regulatory agencies to provide pharmacists with the approvals and waivers needed to change their processes when necessary ([New Jersey Division of Consumer Affairs, 2020](#)). Pharmacists practicing in LTC began the process of adapting practice to address the changing needs of the population they serve.

LTC pharmacies started piloting projects, including remote order entry to limit employee exposure from person-to-person transmission. This modification reduces the number of pharmacy staff members required to be on-site to those necessary to physically prepare the medications for dispensing. Reducing traffic in the pharmacies results in a greater opportunity for social distancing and reduced consumption of PPE. Limited supplies of medications more often associated with acute illness became a consequence of the increased patient acuity associated with active COVID-19 infections as hospital capacities were reached and the subacute treatment of COVID-19 was delegated to skilled nursing facilities ([AARP, 2020](#)). Pharmacists providing services to these facilities face challenges assuring adequate supplies of IV solutions, comfort care, and targeted drug therapies that are not usually needed to this extent in LTC.

Consultant pharmacists typically perform their work at nursing stations. Consultant pharmacists monitor medication storage, preparation, and administration, and engage with the health professional staff at the site to provide training. During the pandemic, consultant pharmacists performed reviews of drug regimens by accessing electronic health records remotely. This was desirable for infection control by limiting the traffic of personnel moving between different LTC facilities. Medication management in-service education could be delivered remotely using printed information and video meetings. Quality assurance process improvement meetings could be accomplished with remote video meetings. Clinical practice adapted to focus on key areas, including infection management and antimicrobial stewardship, deprescribing of noncritical medications and supplements, consolidation of dosing schedules, and update of facility procedures to

include CDC and CMS guidance and risk reduction strategies.

Antimicrobial stewardship was added to CMS LTC requirements late in 2017, so facilities were building up relatively new programs at the time of the outbreak. Stewardship activities can include both assessing the value of antimicrobial treatments and advising on safety monitoring. The introduction of a novel and highly infectious disease such as COVID-19 presented a challenge to clinicians. By the time the coronavirus spread to the US, some medications such as hydroxychloroquine with and without azithromycin had been tried with limited success, but no treatment had been proven safe and effective. Even when these medications are started in the hospital, consultant pharmacists in LTC can suggest continued monitoring and point out drug interactions on admission. Tracking and reporting within an antimicrobial stewardship program is extremely valuable when there is no standard treatment. Pharmacists are actively participating in this process as well

as identifying medication management procedures, which help contain infection (Table 50.5).

Staffing shortages due to illness and addition of hastily trained replacements in LTC buildings has become commonplace in areas known as “hot spots” for COVID-19. Deprescribing and dose consolidation are done to decrease the time needed for medication preparation and administration to allow nursing department staff more time for direct care activities. Infection risk-reducing changes to a drug regimen can include transition from nebulizers to metered dose inhalers (with a spacer if indicated) as well as reevaluation of necessary frequency of drug delivery and monitoring procedures. Long-acting medications and sustained release dosage forms can replace short-acting medications when patients are able to swallow and tolerate the alternatives. When longer acting agents are administered more than once daily, as in the case of proton pump inhibitors, a reduction or consolidation of doses may be tried.

**TABLE 50.5** Examples of COVID-19 Medication Management Responses by Consultant Pharmacists.

| Recommendation  | Intervention type               | Goal  | Considerations   |
|---|---------------------------------|---|--|
| Replace nebulized solutions with metered dose inhalers  | Change in delivery system       | Reduce dispersal of aerosolized droplets to decrease risk of viral transmission | Use of a spacer may be needed for coordinating breathing with administration or due to poor inspiratory capacity |
| Discontinue noncritical eye drops and nasal spray   | Deprescribing                   | Reduction of close contact between staff and infected residents                 | Review diagnosis and medical history for critical indications  |
| Change from a short acting to a long-acting medication (med)  | Consolidation                   | Decrease medication preparation and administration time                         | Review diagnosis and lab work for factors which would exclude long-acting options                                |
| Change from immediate to extended release formulations  | Consolidation                   | Decrease medication preparation and administration time                         | Review ability to swallow medications whole and consider size of the dosage form                                 |
| Combine long-acting doses that are administered more frequently than necessary                                  | Consolidation                   | Decrease medication preparation and administration time                         | Consider whether the dose can be reduced based on patient status   |
| Change “off-time” meds to coincide with policy med times  | Consolidation/deprescribing     | Decrease the number of times entering a resident’s room                         | Review for significant drug interactions and times required for clinical effect                                  |
| Discontinue medications with long range treatment goals   | Deprescribing                   | Decrease medication preparation and administration time                         | Plan to reevaluate after the crisis  |
| Place intermediate goal medications on hold   | Deprescribing                   | Decrease medication preparation and administration time                         | Duration of hold can be specified and reevaluated  |
| Liberalize medication administration times to include a range such as: morning, afternoon, evening, and bedtime | Policy and Procedure adaptation | Remove time restrictions to accommodate immediate patient care needs            | Specify medications which must be delivered at specified times   |

It became helpful to eliminate (deprescribing) or liberalize outlier medication administration times by administering medication doses together. This is one approach which could be used in the absence of a clinically significant drug interactions. Medications ordered for long-term goals such as bisphosphonates, statins, vitamins, and herbal products can be discontinued or placed on temporary hold. Other helpful strategies include simplifying delivery systems as well as changing medications from crushed to unit dose liquids. Facility policy can be adopted to liberalize medication administration times to allow for an expanded window of time. This may not apply to all circumstances (such as antibiotics, antiparkinsonian medications, and other predetermined medications and circumstances) (University of Maryland School of Pharmacy—The Peter Lamy Center of Drug Therapy and Aging, 2020).

Deprescribing also provides the benefit of reducing introduction of outside materials into resident areas. Every vial, box or bag, medication delivery tote, and removable medications cart tray requires decontamination before and after entry into a building with known cases. Pharmacy delivery to the facility entrance instead of to the patient care units has been introduced where necessary to limit traffic into facilities. Many LTC pharmacies have suspended accepting returns and sought out creative ways to restock automated medication dispensing machines and emergency kits. The CMS State Operations Manual requires that “each resident’s drug regimen be free from unnecessary drugs.” The removal of noncritical medications goes beyond this mandate and therefore it is necessary to have a plan to reintroduce/reevaluate necessary but noncritical medications when the crisis has passed

[American Society of Consultant Pharmacists (ASCP), 2020].

CPAs between the medical director and consultant pharmacists are being used, based on state regulations, allowing them to implement measures to decrease burden on LTC facility staff and providers (University of Maryland School of Pharmacy—The Peter Lamy Center of Drug Therapy and Aging, 2020). Pharmacist functioning outside of an agreement can formulate treatment adjustment plans, which must be forwarded to a prescriber for action. Use of CPAs eliminates redundant work in emergent situations such as a pandemic.

There are several lessons learned from the COVID-19 pandemic. LTC facilities without complete electronic access will need to improve their systems moving forward. Pharmacists and all healthcare providers must have timely access to patient electronic health records. Telemedicine is used to deliver medical care remotely by providing a consultation between the provider and patient. Telehealth can be used to supplement on-site visits, expand care to patients, and enhance facility access to consultant pharmacists. State pharmacy organizations can be instrumental in enlisting stakeholders to evaluate and enact needed changes that affect practice in a state. Although facility access is needed for the provision of all pharmacist services in LTC, emergency adaptations have been utilized to limit transmission of this highly contagious virus. Identified as essential, pharmacists practicing in LTC, both in pharmacies and as consultants, have been adjusting their practice during the COVID-19 pandemic to best protect the 1.7 million Americans residing in long-term facilities [Centers for Disease Control and Prevention (CDC), 2020m].

#### **BOX 50.6 Response from academic pharmacy**

The New York–New Jersey region has eight pharmacy schools (ACPE, 2020). These pharmacy programs, along with other health-care programs, sought to continue to provide didactic and experiential education for essential student healthcare professional. These efforts occurred during an historic time in the region considered to be the epicenter of COVID-19 in the US during a state of emergency (CNN, 2020a,b,c). As schools and businesses transitioned to remote operations, pharmacy programs were challenged by the complexity of the curriculum, including laboratory courses, high stakes examinations and competency assessments, and direct patient-care experiential hours (ACPE, 2020).

There were many challenges that arose from the nature of increased risk for infection exposure on rotations. Some challenges involved managing issues related to sites requesting to defer start of health-care student rotations, replacement of clinic visits with telehealth (ambulatory care sites), sites that were limiting student’s role to help with essential operations and patient care (health system, community pharmacies), and sites that allowed for remote work, such as pharmaceutical companies. These variations in offerings could be a barrier in delivering consistent educational opportunities to students. However, there were advantages such as providing alternatives for students preferring or requiring self-quarantine and facilitating meeting graduation requirements on time.

*(Continued)*



**BOX 50.6 (Continued)****External guidance**

Pharmacy programs sought guidance from other health profession programs, as well as Accreditation Council for Pharmacy Education (ACPE), American Association of Colleges of Pharmacy (AACP), and CDC. During this time, medical students had been removed from clinical training by the American Association of American Colleges (AAMC, 2020). ACPE stated that nontraditional coursework and practice experiences may be explored and that experiential hours were to be supervised and were to meet established standards. AACP compiled a “curriculum log” where pharmacy schools could share their plans with others (ACPE, 2020). The CDC published “Interim Guidance for Administrators of US Institutions of Higher Education: Plan, Prepare, and Respond to Coronavirus Disease 2019 (COVID-19),” which offered guidance on preventing the transmission of COVID-19 to faculty, staff, and students on campus [Centers for Disease Control and Prevention (CDC), 2019]. None of these, however, specified how to carry out the pharmacy curriculum, and schools and colleges gathered faculty and staff to develop and implement plans that met the needs of their academic communities.

**Didactic and laboratory education**

Didactic and laboratory courses moved to synchronous and asynchronous online learning through videoconference programs, which were accessible on the Internet, and web-based course learning management systems. Video conferencing and online course management systems were utilized to a greater extent than usual to supplement resources and assignment submissions. Professors worked quickly to adapt courses to online low-tech platform, in many cases, without any formal training or experience in online course teaching, and despite it typically taking 6 months or more to develop an online course (Chronicle, 2020a). It has been argued that this quick shift from classroom to device will “give online learning a bad name” because this “scrambling” has none of the planning, designing, developing, and implementation of true and intentional online education (Chronicle, 2020b). Subsequent challenges arose from security concerns as seen with the popular videoconference platform, Zoom Video Communications, leading to a new term “Zoom-bombing” where uninvited persons enter an online meeting/room to spy or as a prank. This led to information technology and cybersecurity experts to regularly update settings and disseminate changes to educators and learners (Forbes, 2020). Student factors also affect the adaptation of courses to online teaching (Table 50.6).

**Experiential education**

Universities struggled with legal and ethical issues in having students provide patient care while remaining safe and conserving PPE. Many health-care systems no longer allowed students at their sites as well. ACPE requires 300 hours in Introductory Pharmacy Practice Experience (IPPE) and 1440 hours in Advanced Pharmacy Practice

Experience (APPE). Of the 1440 APPE hours, more than 50% must be in direct patient-care settings and must include at least 160 hours each in community pharmacy, ambulatory care, hospital/health-system pharmacy, and inpatient general medicine (ACPE, 2015). Since COVID-19 became widespread in New York–New Jersey in early March 2020, experiential hour documentation was reviewed for students to explore if any completed elective rotations could be used to fulfill requirements for required rotations. ACPE allowed temporary exemptions for one of four required rotations if students had work experience in that setting *and* took a “test” to demonstrate competencies were met *and* if the school developed policies for this strategy *and* if students still fulfilled the same number of hours at an elective rotation (Engle, JP, Mar 20, 2020, Personal Communication). The requirements for students graduating in May 2020 were evaluated and assigned to rotations on a case-by-case basis described in Box 50.7.

Schools also reported fostering patient access and collaboration with prescribers using these technology innovations: remote access to the patients’ EHR, use of telehealth to conduct patient visits, and performing medication reconciliations and counseling telephonically. Pharmacy students were engaged with other professionals using remote group activities and discussion and delivering presentations. Nontraditional electives were utilized with rotations at the departments of health, professional organization executive management, and pharmaceutical industry. Students were empowered to make decisions on delaying the start of rotations, which would impact graduation date. In addition, the faculty administration was cognizant that extended emergency might delay start of experiential rotations for the class of 2021.

Interprofessional education (IPE) requirements were met using videoconference discussions with guest speakers and group activities with students from different professions. This experience was conducive for sharing and engaging with other disciplines. Some examples are described in Table 50.7. The videoconference platform was also used to host multiple cocurricular activities on leadership, health literacy, self-confidence, journal club, and ethics.

Changes in assessment were inevitable as online platforms offer ways to circumvent academic integrity during test taking. One approach involves modifying assessments by implementing open-book tests and quizzes, discussions, and presentations when possible. Examinations that could not be adapted, such as National Pharmacy Licensure Examination (NAPLEX) practice tests, were administered with online faculty proctoring with student cameras on and a visual “tour” of their workspace with their device camera.

Challenges kept coming and professors, preceptors, and students quickly responded to a rapidly changing environment during this historic time. Technology and nontraditional experiences were encouraged and embraced to meet the needs of both the school and patient communities.

(Continued)



## BOX 50.6 (Continued)

**TABLE 50.6** Student barriers to the shift from classroom to online courses during COVID-19.

|                         |  |
|-------------------------|--|
| Technology              | <ul style="list-style-type: none"> <li>• Knowledge of technology</li> <li>• Access to devices (having no computer, sharing with others in the household)</li> <li>• Limited or no Internet access</li> <li>• Limited Internet data</li> <li>• Access to printer, scanner, camera on device</li> </ul>  |
| Financial               | <ul style="list-style-type: none"> <li>• Are essential healthcare workers who are working more often</li> <li>• Lost their jobs, or family members lost their jobs, leading to food insecurity and other financial challenges</li> </ul>   |
| Health                  | <ul style="list-style-type: none"> <li>• Getting ill</li> <li>• Caring for ill family members</li> <li>• Social isolation leading to mental health issues</li> </ul>   |
| Family and psychosocial | <ul style="list-style-type: none"> <li>• Have children at home (infants, toddlers, school-age) who require their attention</li> <li>• Living with abusers or are unwelcome in their home environment</li> <li>• Embarrassed of their surroundings and do not want to use cameras during meetings</li> <li>• Have no desire to take an online course</li> </ul> |

Source: Adapted from <https://anygoodthing.com/2020/03/12/please-do-a-bad-job-of-putting-your-courses-online/>.

**TABLE 50.7** Interprofessional activities implemented using videoconferences.

| Professional        | Topic                                  | Activity description   |
|---------------------|--|--|
| Physician (MD), PhD | Collaboration in public health         | Before the activity: complete free online one hour public health course; explore CDC website                                     |
|                     |  | Followed by online 45-min discussion   |
| Physical therapist  | Collaboration in orthopedic patients   | Before the activity: read an article on vitamin D and fall risks   |
|                     |  | Followed by online 45-min discussion   |
| Physician (DO)      | Collaboration in PhRMA                 | Before the activity: read an article on the role of medical science liaisons   |
|                     |  | Followed by online 45-min discussion   |
| Physician (MD)      | The NICU population                    | Before the activity: watch an online video of a tour of a NICU, taking notes on the medications that were mentioned in the video |
|                     |  | Followed by online 45-min discussion   |
| Dietitian           | Malnutrition in the acute care setting | Before the activity: read a metaanalysis on fish oil in the ICU  |
|                     |  | Followed by 45-min online discussion   |
| Nursing students    | Teamwork and communication             | Before the activity: read Interprofessional Education Collaborative 2016 document  |
|                     |  | Followed by 90 min group activity to watch a video on communication and critique in groups                                       |

CDC, Centers for Disease Control and Prevention; ICU, intensive care unit; NICU, neonatal intensive care; PhRMA, pharmaceutical industry.

(Continued)

**BOX 50.6 (Continued)****References for Academic response**

Accreditation Council for Pharmacy Education (ACPE), 2015. Accreditation standards and key elements for the professional degree program in pharmacy leading to the Doctor of Pharmacy degree (Standards 2016). Available at: <https://www.acpe-accredit.org/pdf/Standards2016FINAL.pdf>

CDC, 2019. Interim guidance for administrators of US institutions of higher education. [online]. Available at: <https://www.cdc.gov/coronavirus/2019-ncov/community/guidance-ihe-response.html> [Accessed 5 May 2020].

Cable News Network (CNN), 2020a. New York coronavirus explainer. [online] Available at: <https://www.cnn.com/2020/03/26/us/new-york-coronavirus-explainer/index.html> [Accessed 5 May 2020].

CNN, 2020b. Novel coronavirus briefing: Governor Cuomo declares state of emergency to contain spread of virus. [online] Available at: <https://www.governor.ny.gov/news/novel-coronavirus-briefing-governor-cuomo-declares-state-emergency-contain-spread-virus> [Accessed 5 May 2020].

CNN, 2020c. Governor Murphy Declares State of Emergency, Public Health Emergency to Strengthen State Preparedness to Contain the Spread of COVID-19 [online] Available at: <https://www.nj.gov/governor/news/news/562020/20200309b.shtml> [Accessed 5 May 2020].

O’Flaherty, K., 2020. Zoom security tip: Avoid the app and do this instead, here’s why. [online] Forbes: Cybersecurity. Available at: <https://www.forbes.com/sites/kateoflahertyuk/2020/04/29/zoom-security-tip-avoid-the-app-and-do-this-instead-heres-why/#b1d5f3148d96> [Accessed 5 May 2020].

The Association of American Medical Colleges (AAMC), 2020. Important guidance for medical students on clinical rotations during the coronavirus (COVID-19) outbreak. [online] Available at: <https://www.aamc.org/news-insights/press-releases/important-guidance-medical-students-clinical-rotations-during-coronavirus-covid-19-outbreak> [Accessed 5 May 2020].

**Further reading**

Bessette, L.S., Chick, N., Friberg, J.C., 2020. 5 myths about remote teaching in the COVID-19 crises. [online] Chronicle of Higher Education: Advice. Available at: <https://www.chronicle.com/article/5-Myths-About-Remote-Teaching/248688?cid=cp275> [Accessed 5 May 2020].

Supiano, B., 2020. Why you shouldn’t try to replicate your classroom teaching online. [online] Chronicle of Higher Education: Teach. Available at: <https://www.chronicle.com/article/Why-You-Shouldn-t-Try-to/248664?cid=cp275> [Accessed 5 May 2020].

**BOX 50.7 Requirements for graduation during COVID-19**

If all four *required APPE rotations were met and 1440 hours were met*, the student did not have to continue rotations.

If all four *required APPE rotations were met*, but the student *needed direct patient-care hours*, the student was moved to a direct patient-care site that was still taking students (either in person or via telehealth).

If all four *required APPE rotations were not met*, the student was put in a remote rotation at an appropriate site with a

clinical faculty member or the student was put in an appropriate site that was still taking students (either in person or via telehealth).

If all four *required APPE rotations were met*, and the *direct patient-care hours were met*, the student was put into an elective remote rotation or to a site that was still taking students.

Students also had the *option to defer* this final rotation block until summer, receiving their degree in fall 2020.

**50.10 Conclusion**

An infectious pandemic leads to the somber fact that people, healthcare professionals included, will die. This chapter ends with words to empower the readers during an emergency infectious pandemic. The Director-General of the WHO, Dr. Tedros Adhanom Ghebreyesus, summarized four key areas: “first, prepare and be ready; second, detect, protect, and treat; third, reduce transmission; and fourth, innovate and learn” [World Health Organization (WHO), 2020a]. Pharmacists should also lead. Pharmacy leaders should be empowered to use lessons learned from the pandemic response to engage the profession to “move the needle” on critical initiatives.

Pharmacists played a key role in the disaster response and mitigation efforts for the COVID-19 pandemic. Significant strides were made in teamwork, communication, medication management systems, and development of policies and procedures. Unprecedented challenges with drug shortages and limited availability of high-quality data in many ways advanced clinical practice, but we may also see evidence of harm in years to come as more trials and evidence become available.

To mitigate the challenges faced during the COVID-19 pandemic in potential future pandemics, best practices for disaster management in the modern era need to be put into place, be maintained, reviewed frequently, and regular training implemented. Pharmacy educators and professional organizations can play roles in implementing training that fosters best practices in the curriculum and for licensed pharmacists. These processes should focus on ethical allocation of medications, resources, and supplies, including having method of evaluating treatment modalities through a team composed of experts. Streamlined communication workflows, chains of command, and processes for establishing standards of care as well as what would be considered acceptable patient-specific variances emerged.

Pharmacists in practice must have mechanisms in place for rapid evaluation of medical information and literature as it becomes available and mechanisms for addressing requests for use of off-label treatment options outside of clinical trials and with limited data available. In 2020, through social media and the Internet, there was rapid exchange of scientific research information and nonresearch

data regarding drugs, therapeutic interventions, and testing. Pharmacists assumed leadership role to sift through information as highly trained scientists evaluating and critiquing the life science and biomedical information sources.

Maintaining relationships with suppliers, manufacturers, staffing resources, and other key stakeholders involved in medication, supply, and labor supply chains was also essential. The COVID-19 pandemic revealed astonishing gaps due to disruptions in drug and PPE supply chains. Pharmacists, with their expertise in system-based approaches to safety and drug use, should advocate for a larger presence in public health, including training pharmacists to pursue leadership roles in many of the HHS branches.

The pharmacy workforce must be flexible to adjust to increased demand in a region affected by weather-related disasters, terrorist attacks, and infectious epidemic emergencies. National and state leaders should evaluate barriers that may hinder shifting the workforce to needed areas. Are there new opportunities? Perhaps, we can promote awareness to these opportunities for pharmacists-in-training and retired pharmacists such as volunteering for the Medical Reserve Corps (<https://mrc.hhs.gov/homepage>) and American Red Cross (<https://www.americanredcross.org>).

The response in the infectious pandemic was administered by numerous federal and state government agencies such as HHS, FEMA, FDA, and department of health of each state. This reality underscores the priority and importance for supporting the government affairs arms of our pharmacy organizations. We must continue to promote opportunities in government affairs. These leaders have the knowledge and know-how, which are instrumental for developing strategies to advocate to policymakers on behalf of the pharmacy profession.

There were excellent examples of interdisciplinary communication and teamwork through development of practice guidelines [National Institute of Health (NIH), 2020; Alhazani, 2020]. This teamwork is a measure of success when we ensure that healthcare professionals are “educated together and train in team-based skills” to fulfill the recommendations from Institute of Medicine, now the National Academy of Medicine (Institute of Medicine, US Committee on the Health Professions Education Summit et al., 2003).

The limitations and opportunities for global communication were apparent. A global solution was needed to manage this emergency and develop new therapies for treating or mitigating the viral infection. Pharmacists across the planet need rapid access to reliable information and web-based kiosks designed for the pharmacy profession could help build global connections. Leaders should create a vision to foster global health communication using the Internet and digital systems to foster communication amongst all healthcare professionals, professional organizations, educational institutions, and the healthcare industry.

Pharmacists, health professionals, and citizens are hopeful for attenuation of the virus and rapid development and deployment of a COVID-19 vaccine. Pharmacists should continue to use their training, innovative thinking, and scientific approach to participate in research and clinical trials, promote awareness and prevention of COVID-19 infection, and be involved in elucidating risk factors and characteristics of the COVID-19 disease.

There is a role for everyone. Pharmacists, pharmacy technicians, and pharmacy students may be involved in many ways. We can continue to be involved in promoting awareness to legislative policies affecting practice, scientific developments, and public health guidance statements. We must respond by serving our patients, by advocating for expanded roles for pharmacists, and responding with professional accountability.

## References

- AARP, 2020. Nursing homes balk at COVID patient transfers from hospitals. [online]. <<https://www.aarp.org/caregiving/health/info-2020/coronavirus-transfers-to-nursing-homes.html>> (accessed 29.04.20; 30.04.20.).
- American Society of Consultant Pharmacists (ASCP), 2020. COVID19 (SARS-COV-2) pandemic: medication management strategies. In: ASCP Collaborative COVID-19 Task Force. [online]. Available from: <[https://cdn.ymaws.com/www.ascp.com/resource/resmgr/docs/disaster/covid-19\\_\\_sars-cov-2\\_\\_pandem.pdf](https://cdn.ymaws.com/www.ascp.com/resource/resmgr/docs/disaster/covid-19__sars-cov-2__pandem.pdf)> (accessed 30.04.20.).
- Alhazani, W., Moller, M.H., Arabi, Y.M., Loeb, M., Gong, M.N., Fan, E., et al., 2020. Surviving Sepsis Campaign: Guidelines on the Management of Critically Ill Adults With Coronavirus Disease 2019 (COVID-19). [Epub ahead of print]. Available from: <[https://journals.lww.com/ccmjournals/Abstract/onlinefirst/Surviving\\_Sepsis\\_Campaign\\_Guidelines\\_on\\_the.95707.aspx](https://journals.lww.com/ccmjournals/Abstract/onlinefirst/Surviving_Sepsis_Campaign_Guidelines_on_the.95707.aspx)> (accessed 30.04.20.).
- American College of Cardiology (ACC), 2020a. Ventricular Arrhythmia Risk Due to Hydroxychloroquine-Azithromycin Treatment. [online]. Available from: <<https://www.acc.org/latest-in-cardiology/articles/2020/03/27/14/00/ventricular-arrhythmia-risk-due-to-hydroxychloroquine-azithromycin-treatment-for-covid-19>> (accessed 30.04.20.).
- American College of Cardiology (ACC), 2020b. HFSA/ACC/AHA Statement Addresses Concerns re: Using RAAS Antagonists in COVID-19. [online]. Available from: <<https://www.acc.org/latest-in-cardiology/articles/2020/03/17/08/59/hfsa-acc-aha-statement-addresses-concerns-re-using-raas-antagonists-in-covid-19>> (accessed 30.04.20.).
- American College of Clinical Pharmacy, 2020. Response to Health and Human Services Statements on Authorizing Licensed Pharmacists to Order and Administer COVID-19 Tests. Available from: [file:///C:/Users/Owner/Downloads/HHS\\_COVID-19\\_TESTSAFETY.pdf](file:///C:/Users/Owner/Downloads/HHS_COVID-19_TESTSAFETY.pdf) (accessed 16.04.20; 30.04.20.).
- American Society of Health-System Pharmacists, 2020a. Assessment of evidence for COVID-19-related treatments. [online] Available at: <https://www.ashp.org/-media/assets/pharmacy-practice/resource-centers/Coronavirus/docs/ASHP-COVID-19-Evidence-Table.ashx?la=en&hash=B414CC64FD64E1AE8CA47AD753BA744EDF4FFB8C> (accessed 30.04.20.).

- American Society of Health System Pharmacists (ASHP), 2020b. Stewardship of Off-Label Treatments for COVID-19. [online]. Available from: <<https://www.ashp.org/-/media/assets/pharmacy-practice/resource-centers/Coronavirus/docs/Stewardship-of-Off-Label-Treatments.ashx?loc=ashphero5-stewardship-off-label-03232020>> (accessed 30.04.20.).
- Arons, M.M., Hatfield, K.M., Reddy, S.C., Kimball, A., James, A., Jacobs, J.R., et al., 2020. Presymptomatic SARS-CoV-2 infections and transmission in a skilled nursing facility. *N. Engl. J. Med.* Available from: <https://doi.org/10.1056/NEJMoa2008457> [Epub ahead of print] PubMed PMID: 32329971.
- Bao, C., Wang, Y., Wen, D., Liu, W., Wang, J., Fang, F., et al., 2020. The trial of lopinavir-ritonavir in adults hospitalized with severe COVID-19. *N. Engl. J. Med.* 382. doi:[10.1056/NEJMoa2001282](https://doi.org/10.1056/NEJMoa2001282).
- Bhatraju, P.K., Ghassemieh, B.J., Nichols, M., Kim R., Jerome, K.R., Nalla, A.K., et al., 2020. Covid-19 in critically ill patients in the Seattle region—case series. *N. Engl. J.* 382. <https://doi.org/10.1056/NEJMoa2004500>.
- Bhimraj, A., Morgan, R.L., Shumaker, A.H., Laverigne, V., Baden, L., Cheng, V.C., et al., 2020. Infectious Diseases Society of America Guidelines on the treatment and management of patients with COVID-19. *Clin. Infect. Dis.* ciaa478. doi:[10.1093/cid/ciaa478](https://doi.org/10.1093/cid/ciaa478).
- Calderon, R.M., Cubeddu, L.X., Goldberg, R.B., et al., 2010. Statins in the treatment of dyslipidemia in the presence of elevated liver aminotransferase levels: a therapeutic dilemma. *Mayo Clin. Proc.* 85 (4), 349–356. Available from: <https://doi.org/10.4065/mcp.2009.0365>.
- Centers for Disease Control and Prevention (CDC), 2020a. Severe Acute Respiratory Syndrome. [online]. Available from: <<https://www.cdc.gov/sars/index.html>> (accessed 30.04.20.).
- Centers for Disease Control and Prevention (CDC), 2020b. Information for pediatric healthcare providers. In: Covid-19. [online]. Available from: <[https://www.cdc.gov/coronavirus/2019-ncov/hcp/pediatric-hcp.html#anchor\\_1589580133375](https://www.cdc.gov/coronavirus/2019-ncov/hcp/pediatric-hcp.html#anchor_1589580133375)> (updated 15.05.20; accessed 17.05.20.).
- Centers for Disease Control and Prevention (CDC), 2020c. Public Health Professionals Gateway: Telehealth and Telemedicine. [online]. Available from: <<https://www.cdc.gov/phlp/publications/topic/telehealth.html>> (accessed 30.04.20.).
- Centers for Disease Control and Prevention (CDC), 2020d. Pneumonia: Pneumonia Can Be Prevented – Vaccines Can Help. [online]. Available from: <<https://www.cdc.gov/pneumonia/prevention.html>> (accessed 30.04.20.).
- Centers for Disease Control and Prevention (CDC), 2020e. Immunization Schedules: Schedule Changes and Guidance. [online]. Available from: <<https://www.cdc.gov/vaccines/schedules/hcp/schedule-changes.html>> (accessed 30.04.20.).
- Centers for Disease Control and Prevention (CDC), 2020f. National Trends for Common Human Coronavirus. [online]. Available from: <<https://www.cdc.gov/surveillance/nrevss/coronavirus/natl-trends.html>> (accessed 30.04.20.).
- Centers for Disease Control and Prevention (CDC), 2020g. Coronavirus Disease 2019 (COVID-19): Guidance for Pharmacists. [online]. Available from: <<https://www.cdc.gov/coronavirus/2019-ncov/health-care-resources/pharmacies.html>> (accessed 30.04.20.).
- Centers for Disease Control and Prevention (CDC), 2020h. Strategies to Optimize the Supply of PPE and Equipment. [online]. Available from: <<https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/index.html>> (accessed 29.04.20.).
- Centers for Disease Control and Prevention (CDC), 2020i. People Who Are at Higher Risk for Severe Illness. [online]. Available from: <<https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-at-higher-risk.html>> (accessed 30.04.20.).
- Centers for Disease Control and Prevention (CDC), 2020j. Coronavirus Disease 2019–Older Adults. [online]. Available from: <<https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/older-adults.html>> (accessed 30.04.20.).
- Centers for Disease Control and Prevention (CDC), 2020k. Interim U.S. Guidance for Risk Assessment and Public Health Management of Healthcare Personnel With Potential Exposure in a Healthcare Setting to Patients With Coronavirus Disease (COVID-19). [online]. Available from: [cdc.gov/coronavirus/2019-ncov/hcp/guidance-risk-assessment-hcp.html](https://www.cdc.gov/coronavirus/2019-ncov/hcp/guidance-risk-assessment-hcp.html)> (accessed 30.04.20.).
- Centers for Disease Control and Prevention (CDC), 2020l. Interim Guidance for Healthcare Facilities: Preparing for Community Transmission of COVID-19 in the United States. [online]. Available from: <<https://www.cdc.gov/coronavirus/2019-ncov/healthcare-facilities/guidance-hcf.html>> (accessed 30.04.20.).
- Centers for Disease Control and Prevention (CDC), 2020m. Nursing Home Care. [online]. Available from: <<https://www.cdc.gov/nchs/fastats/nursing-home-care.htm>> (accessed 30.04.20.).
- Department of Health Washington State, 2019. Emergencies: 2019 Novel Coronavirus Outbreak 2019. [online]. Available from: <<https://www.doh.wa.gov/Emergencies/Coronavirus>> (accessed 30.04.20.).
- Emanuel, E.J., Persad, G., Upshur, R., Thome, B., Parker, M., Glickman, A., et al., 2020. Fair allocation of scarce medical resources in the time of Covid-19. *N. Engl. J. Med.* 382. doi:<https://doi.org/10.1056/NEJMs2005114>.
- Fang, L., Karakiulakis, G., Roth, M., 2020. Are patients with hypertension and diabetes mellitus at increased risk for COVID-19 infection? *Lancet Respir. Med.* 8 (4), e21. Available from: [https://doi.org/10.1016/S2213-2600\(20\)30116-8](https://doi.org/10.1016/S2213-2600(20)30116-8). Epub 11.03.20.
- Federal Emergency Management Agency (FEMA).gov, 2020. President Donald J. Trump Directs FEMA Support Under Emergency Declaration for COVID-19. [online]. Available from: <<https://www.fema.gov/news-release/2020/03/13/president-donald-j-trump-directs-fema-support-under-emergency-declaration>> (accessed 30.04.20.).
- Food and Drug Administration (FDA), 2020a. Drug Safety and Availability: FDA Advises Patients Use of Non-Steroidal Anti-Inflammatory Drugs for COVID-19. [online]. Available from: <<https://www.fda.gov/drugs/drug-safety-and-availability/fda-advises-patients-use-non-steroidal-anti-inflammatory-drugs-nsaids-covid-19>> (accessed 30.04.20.).
- Food and Drug Administration (FDA), 2020b. Policy for Diagnostic Tests for Coronavirus Disease-2019 During the Public Health Emergency. [online]. Available from: <<https://www.fda.gov/media/135659/download>> (16.03.20; accessed 19.04.20.).
- Johns Hopkins University & Medicine, 2020. Coronavirus Resource Center. [online]. Available from: <<https://coronavirus.jhu.edu/>> (accessed 30.04.20.).
- Gibbs, J.N., Cato, M.E., Schlanger, S.J., 2020. New FDA policy significantly limits serological testing. In: FDA Law Blog. Available from: <<https://bit.ly/2y7KiOf>> (accessed 19.04.20.).
- Goble, J.A., Rocafort, P.T., 2017. Point-of-care testing: future of chronic disease state management? *J. Pharm. Pract.* 30, 229–237. Available from: <https://doi.org/10.1177/0897190015587696>.
- Grein J., Ohmagari N., Shin D., Diaz G., Asperges E., Castagna A., et al., 2020. Compassionate use of remdesivir for patients with severe Covid-19. *N. Engl. J. Med.* 382. doi:[10.1056/NEJMoa2007016](https://doi.org/10.1056/NEJMoa2007016).



- Gautret, P., Lagier, J.C., Parola, P., Hoang, V.T., Meddeb, L., Mailhe, M., et al., 2020. Hydroxychloroquine and azithromycin as a treatment of COVID-19: results of an open-label non-randomized clinical trial. *Int. J. Antimicrob. Agents* doi:10.1016/j.ijantimicag.2020.105949. Available online 20 March 2020. In Press.
- Gubbins, P.O., Klepser, M.E., Adams, A., Jacobs, D.M., Percival, K., Tallman, G., 2017. Potential for pharmacy-public health collaborations using pharmacy-based point of care testing services. *J. Publ. Health Manage. Pract.* 23, 593–600. Available from: <https://doi.org/10.1097/PHH.0000000000000482>.
- Health and Human Services (HHS), 2020. News: HHS Statements on Authorizing Licensed Pharmacists to Order and Administer COVID-19 tests. [online]. Available from: <https://www.hhs.gov/about/news/2020/04/08/hhs-statements-on-authorizing-licensed-pharmacists-to-order-and-administer-covid-19-tests.html> (accessed 30.04.20).
- Institute of Medicine, US Committee on the Health Professions Education Summit, Greiner, A.C., Knebel, E. (Eds., IOM), 2003. *Health Professions Education: A Bridge to Quality*. National Academies Press, Washington, DC.
- ISMP, 2020. ISMP Medication Safety Alert. Newsletter. April 30, 2020. Volume 25. Issue 6. Supplement. pages 1–4.
- Kerneuzet, I., Blind, E., Darrieux, L., et al., 2018. Ivermectin-induced drug reaction with eosinophilia and systemic symptoms (DRESS) syndrome. *JAAD Case Rep.* 4 (6), 524–527. Available from: <https://doi.org/10.1016/j.jdcr.2018.05.002>.
- Klepser, D.G., Klepser, M.E., Smith, J.K., Dering-Anderson, A.M., Nelson, M., Pohren, L.E., 2018. Utilization of influenza and streptococcal pharyngitis point-of-care testing in the community pharmacy practice setting. *Res. Soc. Admin. Pharm.* 14, 356–359. Available from: <https://doi.org/10.1016/j.sapharm.2017.04.012>.
- Klepser, D.G., Klepser, M.E., Murry, J.S., Borden, H., Olsen, K.M., 2019. Evaluation of a community pharmacy-based influenza and Group A streptococcal pharyngitis disease management program using polymerase chain reaction point-of-care testing. *J. Am. Pharm. Assoc.* 59, 872–879. <https://doi.org/10.1016/j.japh.2019.07.011>.
- McMichael, T.M., Clark, S., Pogosjans, S., et al., 2020. COVID-19 in a long-term care facility—King County, Washington, February 27–March 9, 2020. *MMWR Morb. Mortal. Wkly. Rep.* 69, 339–342. <https://doi.org/10.15585/mmwr.mm6912e1>.
- National Alliance of State Pharmacy Associations (NASPA), 2020a. State Policy Resources. [online]. Available from: <https://naspa.us/restopic/state-policy/> (accessed 30.04.20).
- National Alliance of State Pharmacy Associations (NASPA), 2020b. Public Health Resources: COVID-19: Telehealth. [online]. Available from: <https://naspa.us/restopic/public-health/> (accessed 30.04.20).
- National Alliance of State Pharmacy Associations (NASPA), 2020c. State Policy Resources: COVID-19 Testing. [online]. Available from: <https://naspa.us/resource/covid-19-testing/> (accessed 30.04.20).
- National Institute of Health (NIH), 2020. COVID-19 Treatment Guidelines. [online]. Available from: <https://covid19treatmentguidelines.nih.gov/> (accessed 30.04.20).
- National Community Pharmacists Association (NCPA), 2020. Community Pharmacy Best Practices for COVID-19 Responses. [online]. Available from: <https://ncpa.org/coronavirus-information> (accessed 30.04.20).
- Netzer, G., Liu, X., Shanholtz, C., Harris, A., Verceles, A., Iwashyna, T. J., 2011. Decreased mortality resulting from a multicomponent intervention in a tertiary care medical intensive care unit. *Crit. Care Med.* 39 (2), 284–293. Available from: <https://doi.org/10.1097/CCM.0b013e3181ffdd2f>. PMID: 21076286.
- New Jersey Department of Health, 2020. New Jersey COVID-19 Data Dashboard. [online]. Available from: <https://covid19.nj.gov/#live-updates> (accessed 30.04.20).
- New Jersey Division of Consumer Affairs, 2020. Board of Pharmacy. [online]. Available from: <https://www.njconsumeraffairs.gov/phar/Pages/applications.aspx> (accessed 30.04.20).
- New York State Department of Health, 2020. NYSDOH Covid-19 Case Tracker. [online]. Available from: <https://covid19tracker.health.ny.gov/views/NYS-COVID19-Tracker/NYSDOHCovid-19Tracker-Map?%3Aembed=yes&%3Atoolbar=no&%3Atabs=n> (accessed 30.04.20).
- Pawar, A., Desai, R.J., Solomon, D.H., et al., 2019. Risk of serious infections in tocilizumab versus other biologic drugs in patients with rheumatoid arthritis: a multidatabase cohort study. *Ann. Rheum. Dis.* 78 (4), 456–464. Available from: <https://doi.org/10.1136/annrheumdis-2018-214367>. Epub 24.01.19.
- Riccioni, L., Bertolini, G., Giannini, A., et al., 2020. Clinical ethics recommendations for the allocation of intensive care treatments, in exceptional, resource-limited circumstances. *Recenti Prog. Med.* 111 (4), 207–211. Available from: <https://doi.org/10.1701/3347.33183>.
- Roden D.M., Harrington R.A., Poppas A., Russo A.M., 2020. Considerations for drug interactions on QTc interval in exploratory COVID-19 treatment. *J. Am. Coll. Cardiol.* 75. doi:10.1016/j.jacc.2020.04.016.
- Rome, B.N., Avorn, J., 2020. Drug evaluation during the Covid-19 pandemic. *N. Engl. J. Med.* 382. doi:https://doi.org/10.1056/NEJMp2009457.
- Rubin, S.E., Schulman, R.M., Rosazk, A.R., Hermann, J., Patel, A., Koonin, L.M., 2014. Leveraging partnerships among community pharmacists, pharmacies, and health departments to improve pandemic influenza response. *Biosecur. Bioterror.* 12, 76–84. Available from: <https://doi.org/10.1097/PHH.0000000000000482>.
- Thachil, J., Tang, N., Gando, S., Falanga, A., Catteano, M., Levi, M., et al., 2020. International Society of Thrombosis and Haemostasis interim guidance on recognition and management of coagulopathy in COVID-19. *J. Thromb. Haemost.* 18, 1023–1026. Available from: [doi.org/10.1111/JTH.14810](https://doi.org/10.1111/JTH.14810).
- Silverman, E., 2020. The Coronavirus in China Could Threaten Pharma's Ingredient Source. [online]. Available from: <https://www.statenews.com/pharmalot/2020/01/27/china-coronavirus-pharmaceutical-ingredients> (accessed 30.04.20).
- van Doremalen, N., Bushmaker, T., Morris, D.H., Holbrook, M.G., Gamble, A., Williamson, B.N., et al., 2020. Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1. *N. Engl. J. Med.* 382 (16), 1564–1567. doi:10.1056/NEJMc2004973.
- Vasoo, S., Stevens, J., Singh, K., 2009. Rapid antigen tests for diagnosis of pandemic (swine) influenza A/H1N1. *Clin. Infect. Dis.* 49, 1090–1093. Available from: <https://doi.org/10.1086/644743>.
- White House.gov, 2020. Executive Order Prioritizing Allocating Health and Medical Resources to Respond to the Spread of COVID-19. [online]. Available from: <https://www.whitehouse.gov/presidential-actions/executive-order-prioritizing-allocating-health-medical-resources-respond-spread-covid-19/> (accessed 30.04.20).
- World Health Organization (WHO), 2020a. Virtual Press Conference on COVID-19. [online]. Available from: [https://www.who.int/docs/default-source/coronaviruse/transcripts/who-audio-emergencies-coronavirus-press-conference-full-and-final-11mar2020.pdf?sfvrsn=cb432bb3\\_2](https://www.who.int/docs/default-source/coronaviruse/transcripts/who-audio-emergencies-coronavirus-press-conference-full-and-final-11mar2020.pdf?sfvrsn=cb432bb3_2) (accessed 30.04.20).



- World Health Organization (WHO), 2020b. Coronavirus Disease: Technical Guidance. [online]. Available from: <[https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-\(covid-2019\)-and-the-virus-that-causes-it](https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-(covid-2019)-and-the-virus-that-causes-it)> (accessed 30.04.20.).
- World Health Organization (WHO), 2020c. Advice on the use of point-of-care immunodiagnostic tests for COVID-19, scientific brief, 2020. In: World Health Organization WHO/2019-nCoV/Sci\_Brief/POC\_immunodiagnosics/2020.1. [online]. Available from: <[https://www.who.int/docs/default-source/coronaviruse/sb-2020-1-poc-immunodiagnosics-2020-04-08-e.pdf?sfvrsn=4c26ac39\\_2](https://www.who.int/docs/default-source/coronaviruse/sb-2020-1-poc-immunodiagnosics-2020-04-08-e.pdf?sfvrsn=4c26ac39_2)> (accessed 26.04.20.).
- Zagury-Orly, I., Schwartzstein, R.M., 2020. Covid-19—a reminder to reason. *N. Engl. J. Med.* doi:10.1056/NEJMp2009405.
- Centers for Disease Control and Prevention (CDC), 2019. Infection Control in Healthcare Personnel: Infrastructure and Routine Practices for Occupational Infection Prevention and Control Services. Centers for Disease Control and Prevention. Available from: <<https://www.cdc.gov/infectioncontrol/guidelines/healthcare-personnel/index.html>> (accessed 29.04.20.). Recommendations Only.
- American Society of Health System Pharmacists (ASHP), 2020b. Assessment of Evidence for COVID-19-Related Treatments. [online]. Available from: <<https://www.ashp.org/-/media/assets/pharmacy-practice/resource-centers/Coronavirus/docs/ASHP-COVID-19-Evidence-Table.ashx?la=en&hash=B414CC64FD64E1AE8CA47AD753BA744EDF4FFB8C>> (accessed 30.04.20.).
- University of Maryland School of Pharmacy—The Peter Lamy Center of Drug Therapy and Aging, 2020. Optimizing Medication Management During the COVID19 Pandemic: Implementation Guide for Post-Acute and Long-Term Care. US Deprescribing Research Network (USDeN). [online]. Available from: <[https://www.pharmacy.umaryland.edu/media/SOP/wwwpharmacyumarylandedu/centers/lamy/covid19-med-mgmt/complete-implementation-guide\\_042420.pdf](https://www.pharmacy.umaryland.edu/media/SOP/wwwpharmacyumarylandedu/centers/lamy/covid19-med-mgmt/complete-implementation-guide_042420.pdf)> (accessed 30.04.20.).
- U.S. Department of Health & Human Services Office of the Assistant Secretary for Health, 2020. Guidance for Licensed Pharmacists, COVID-19 Testing, and Immunity Under the PREP Act. U.S. Department of Health & Human Services Office of the Assistant Secretary for Health. Available from: <<https://www.hhs.gov/sites/default/files/authorizing-licensed-pharmacists-to-order-and-administer-covid-19-tests.pdf>>. (accessed 19.04.20.).