

Maintaining comprehensive pharmacy services during a pandemic: recommendations from a designated COVID-19 facility

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Keywords: clinical pharmacy services, COVID-19 pandemic, disaster medicine, emergency preparedness, hospital pharmacy services, pharmacy administration

In the event of a disaster, pharmacists are capable of undertaking crucial roles in hospitals and health systems, including various actions within the 4 phases of disaster management: prevention/mitigation, preparedness, response, and recovery.¹ Previous events have highlighted pharmacists' endeavors to fulfill needs of their patients, institutions, and communities as part of the disaster medicine response.²⁻⁷ The rapid spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and coronavirus disease 2019 (COVID-19) is no exception, and it was declared a pandemic by the World Health Organization in March 2020. In addition to infectious risks and a lack of definitive treatment(s) or an approved vaccine, challenges include surges COVID-19 cases resulting in overwhelmed hospitals, healthcare staffing issues, and critical supply shortages including drugs. Medication management remains an important aspect of care for patients with COVID-19, including management of novel and experimental pharmacologic agents, pharmacotherapy to support life-sustaining and critical care treatments, and drugs needed to treat underlying comorbidities and for chronic disease management.

The University Hospital of Brooklyn at SUNY Downstate Health Sciences University, a tertiary care urban academic medical center in Brooklyn, NY, was declared a designated "COVID 19 only" treatment facility by the governor of New York State, the epicenter of the US outbreak. The hospital leadership, department administrators, and frontline staff worked collaboratively in order to prepare for the influx of patients with COVID-19. The department of pharmacy was tasked with devising and implementing a sustainable action plan for continuity of pharmacy services. Herein, we provide recommendations on maintaining comprehensive pharmacy and medication management services during the COVID-19 pandemic.

Emergency preparedness and disaster management. The department of pharmacy should be routinely involved in emergency preparedness and disaster management on the institutional level.⁸⁻¹⁰ This involvement may include conference calls with the hospital leadership, providers, and administrators of other departments to discuss the evolving COVID-19 situation and/or direct involvement with the hospital incident command system. It is crucial for the department of pharmacy to remain knowledgeable of hospital plans as they are being deliberated, including plans for bed management, opening of treatment areas, conversion of critical care units, and the disposition/transfer process. This knowledge will provide advance notice to deploy resources timely and efficiently. Examples include modifying medication inventory in preexisting automated dispensing cabinets (ADCs) to match the needs of the patient population, redistributing or adding emergency supplies such as crash carts and intubation trays to more acute care units, and reallocating clinical services to accommodate areas of highest need.

During these communications, the department of pharmacy should have a venue to regularly report on specific changes or trends in medication usage during the COVID-19 pandemic, clinical guidelines, staffing plans, and updates on critical drug shortages and inventory management. As the circumstances unfold and develop, the department of pharmacy should concomitantly be creating plans for eventual recovery and plans to be implemented in the event of a potential resurgence, with delineation of action items and responsible personnel. The specifics of these plans may be modified as a result of additional hospital plans, new clinical information, changes in resource allocation, and lessons learned.

Operational pharmacy services. A surge of patients with COVID-19 is expected to correlate with increased needs for operational pharmacy services. As such, medication dispensing functions must be maintained, and available automation resources should be a focus of optimization. For institutions with ADCs, more rapid turnover of supply and higher incidences of stock-outs can be expected; thus, it is prudent to monitor drug utilization and make real-time adjustments, such as modifying par levels and adding delivery/restocking runs when resources allow. Similarly, the high clinical acuity of some patients with COVID-19 may result in more rapid turnover of emergency supplies, including crash carts, airway/intubation trays, and other institution-specific boxes and kits. Turnover and usage can be tracked manually or with automated kit tracking solutions, if available. The department of pharmacy may need to assess the number of carts and kits that are deployed to patient care areas in conjunction with providers and adjust quantities accordingly. Additional pharmacist, pharmacy intern, and pharmacy technician resources may be required to ensure adequate restocking of depleted emergency equipment items, followed by accurate verification. For institutions that involve multiple departments in restocking crash carts (eg, pharmacy, materials management, and central sterile departments), it may be worth initiating a conversation to agree on the most efficient workflow during the COVID-19 pandemic.

Another operational area expected to be impacted is sterile compounding. For institutions that are increasing bed capacity for critically ill and step-down patients with COVID-19, the need for compounded sterile preparations (CSPs) such as continuous-infusion and piggyback medications will likely grow. Inpatients with documented or suspected COVID-19 pneumonia may potentially be instructed to take nothing by mouth for a variety of clinical

reasons, further increasing the demand for CSPs. Depending on the sterile compounding workflow and available resources and technology, increasing the batching frequency for non-patient-specific doses of CSPs may be an option to minimize wastage and improve operational efficiency.^{11,12} Candidates to consider include commonly used critical care medications (eg, vasopressors, sedatives, neuromuscular blocking agents) and antiinfective drugs. Beyond-use dating (BUD) and personal protective equipment (PPE) conservation strategies are also vital considerations during the pandemic. Compliance with the standards set forth in *United States Pharmacopeia* general chapter 797 (“Pharmaceutical Compounding—Sterile Preparations”)¹³ should be followed, but pharmacy personnel involved in sterile compounding should remain vigilant of new communications regarding BUD or PPE conservation strategies from USP, their respective state boards of pharmacy, and other regulatory bodies issuing recommendations or waivers during the COVID-19 pandemic. Before implementing changes to sterile compounding procedures, it is important to consult with appropriate bodies and review applicable laws and requirements.

Under normal conditions, operational pharmacy personnel are often present on patient care units and nursing stations to deliver, restock, and retrieve medications and medication-related equipment. In order to minimize potential exposures and movement throughout patient care areas, institutions with pneumatic tube delivery systems can capitalize on the system to decrease the number of physical deliveries by sending supply either directly to nursing stations or to the nearest inpatient satellite pharmacy, if applicable; acquisition of additional empty carriers may be considered, depending on the system’s maximum capacity. Staff required to visit patient care or isolation areas should be provided with adequate PPE

according to the expected level of exposure and institution-specific guidelines. For medications and medication trays returned from COVID-19 isolation areas, a separate secure location for quarantining of those items for an appropriate period of time before recirculation back into active inventory can be identified. Crash carts returned to the department of pharmacy should be cleaned with approved disinfectants. It may be prudent to agree upon an accepted disinfecting process with individuals who handle and transport crash carts (eg, nursing, security, transport team personnel) and to determine where carts should be located to minimize contamination of carts and their contents, including detailed discussion of cart storage in patient care areas and specific cart placement during an active resuscitation.

Clinical pharmacy services. Clinical pharmacists promote safe and effective medication management in patients with COVID-19, who often have comorbidities in addition to their presenting illness. The pharmacy leadership should collaboratively assess patient care needs with providers and the hospital leadership to develop a plan for continued delivery, allocation, and/or modification of clinical services.¹⁴ For example, select specialty services (eg, ambulatory care, hematology/oncology, solid organ transplantation services) may temporarily decrease their census or not be accepting new patients. If eligible, clinical pharmacists specializing in those areas may be reassigned to inpatient teams caring for patients with COVID-19 but should still maintain involvement and open communication with providers from their specialty-specific service lines. Expansion of critical care and emergency medicine treatment areas may warrant additional clinical pharmacy services to assist in managing increased patient volume and/or acuity to positively impact clinical outcomes.^{15,16} Clinical pharmacists in other specialties who

may have prior critical care or emergency medicine training or experience can be called upon to provide extra coverage and support.

Pharmacy extenders can play an important role in ensuring continuity of pharmacy services. Pharmacy residents who do not yet have a pharmacist license can function as licensed pharmacists and assume clinical and operational responsibilities in tandem with their preceptors, allowing more widespread coverage and pharmacotherapy oversight for a greater number of patients. Residency program leaders can consider switching residents out of or postponing non–direct patient care learning experiences during the COVID-19 pandemic. Program directors and credentialed preceptors should still remain cognizant of requirements and competency areas, goals, and objectives to ensure pharmacy residents remain on track for timely residency completion. Another important area of consideration for a residency program leadership is the potential impact of disaster management on resident stress levels, burnout risk, and other professional and personal obligations.¹⁷ Tactics such as improved planning, scheduling, communication, and utilization of resources should be discussed. If the experiential site and affiliated college of pharmacy have allowed for ongoing student experiences, pharmacy students can be incorporated into the department of pharmacy and provide supplementary services. With proper oversight from preceptors, pharmacy students may assist in executing clinical activities such as obtaining best possible medication histories, managing drug information inquiries, conducting follow-up telephone calls with discharged patients, and delivering educational presentations regarding treatment options and supportive care for COVID-19.

Resourcewise, it may not be possible for every medical team or service to have dedicated clinical pharmacy coverage; this highlights the importance of collaboratively discussing which targeted services (eg, antimicrobial stewardship, medication profile review, review of high-risk medications, therapeutic drug monitoring) can be feasibly delivered. An additional approach could be to leverage “pharmacy acuity” (medication regimen complexity) scoring tools to prioritize patient care needs, if the institution’s electronic medical record (EMR) and/or clinical decision support software possess those capabilities.^{18,19} Depending on the institution’s pharmacy practice model, clinical pharmacists and pharmacy residents can participate in decentralized order verification to provide comprehensive pharmaceutical care and to facilitate operations of the department of pharmacy. In regards to emergency response, there is expected to be an increased number of cardiac arrests, respiratory arrests, code stroke alerts, and other rapid response calls during a COVID-19 case surge. Regardless of whether the institution already deploys pharmacists to participate in these events, it is worthwhile to discuss or revisit expectations with resuscitation committees and teams. Points of discussion may include feasibility and consistency of pharmacist emergency response coverage, staffing requirements, concomitant operational and clinical patient care responsibilities, staff protection and exposure, and preservation of PPE.

Clinical pharmacists should be participating in guideline development in partnership with providers and content experts for management of COVID-19 and associated manifestations, as well as development of guidelines for use of therapeutic alternatives and usage restrictions during critical drug shortages. A major challenge is being able to manage the amount of knowledge and literature released regarding SARS-CoV-2 infection and

pharmacotherapies, including novel treatment approaches and repurposing of older medications. Since the beginning of the pandemic, emerging clinical manifestations and additional disease complications have been discovered in pediatric and adult patients, which will affect treatment options. Moreover, in the highest-acuity patients various other factors, such as multiorgan dysfunction, pharmacokinetic and pharmacodynamic changes, use of extracorporeal therapies, and underlying comorbidities need to be considered, further impacting treatment criteria and complicating drug selection. A proactive approach involves staying abreast of newly released literature, assessing evidence with a hospital-designated multidisciplinary team or workgroup, forming new or modifying existing treatment recommendations, developing consultation and/or approval processes for specific pharmacologic agents, and disseminating timely information and education to healthcare staff. This process of multidisciplinary evaluation, discussion, and decision-making is of extreme importance to maintain and promote safe and cost-conscious medication usage.²⁰

Drug shortage management. As the demand for experimental COVID-19 treatments and medications necessary to support life-sustaining therapies skyrockets, drug supply chains will become strained.²¹ This disruption may include suppliers, manufacturers, and wholesale distributors. Drug shortages add further layers of complexity to medication management during a public health crisis.²² Critical drugs that have already been impacted include opioids, sedatives, vasopressors, neuromuscular blocking agents, respiratory agents and inhalers, and numerous antiinfectives; experimental COVID-19–targeted agents have also been impacted. On an institutional level, the department of pharmacy should collaborate with the pharmacy and therapeutics committee, providers, clinical content experts, and other stakeholders to

disseminate timely drug shortage communications. For example, use of oral opioids and adjunct sedative-analgesic agents can be promoted to potentially minimize the need for intravenous rescue therapy. Intermittent bolus dosing of opioids, sedatives, and neuromuscular blocking agents can be considered in preference to continuous infusion drips as a conservation strategy, if clinically appropriate. Guidelines for critical drug shortage recommendations may include approved restrictions and/or alternative pharmacotherapy options, if applicable.²³

Inventory and supply chain managers should remain in constant contact with wholesale distributors to determine product availability, product allocation, and the status of incoming shipments. The department of pharmacy may also consider contacting manufacturers to obtain personalized availability reports and to directly place emergency purchase orders. Keeping a running vendor list with names of representatives and contact information for internal use may prove to be beneficial when additional drug shortages arise or in the event of a resurgence of COVID-19 cases. Another approach is to collaborate with state and local healthcare organizations and advocacy groups to contact the Federal Emergency Management Agency's state coordinating officers to request immediate release of available quantities of critical medications from the Strategic National Stockpile to a state's department of health. While seeking additional procurement options, the supply chain team and/or other designated individuals should be tasked with keeping accurate inventory counts of critical medications on at least a daily basis. In doing so they should remain cognizant of any closed patient care or procedural areas, as well as any specialty services with a significantly reduced census, as those areas and services may have supplies of necessary drugs that can be centralized and subsequently redistributed to higher-need areas.

Pharmacy informatics and data management. As medication management is crucial for the care of patients with COVID-19, pharmacists with expertise in clinical informatics can play a substantial role in emergency preparedness by applying their knowledge of pharmacy practice, medication safety, health information technology, and clinical information systems.²⁴

Immediate actions involve customized maintenance of the EMR to align with clinician needs.

Custom ordering templates and order sets may be built to simplify medication selection for providers caring for patients with COVID-19. For knowledge delivery, computerized prescriber order entry and clinical decision support systems can be modified to proactively and interactively highlight drug shortages, current restrictions, and appropriate alternatives.

During disaster-related drug shortages, the department of pharmacy may receive medications from a new manufacturer, new dosage forms or volumes, or alternative pharmacologic agents. If the institution utilizes barcode-assisted and/or knowledge-based medication administration technology, pharmacy informaticists should ensure that the technology will recognize previously unencountered National Drug Code numbers so that it continues to enable accurate and safe medication administration.²⁵

In the setting of lack of evidence from randomized controlled trials, hospitals and health systems may wish to gather and analyze institution-specific data to validate current COVID-19 protocols, identify areas of further investigation, or determine if changes in treatment are warranted. Pharmacy informaticists, pharmacists, and pharmacy residents can be part of a multidisciplinary research team or task force to assist with generating usage reports, data collection, data analysis, presentation of results and recommendations for internal process improvement, and potential submission of abstracts or manuscripts to contribute to the

medical literature. If the hospital or health system is participating in randomized trials of experimental therapies for COVID-19, pharmacy informaticists may need to collaborate with investigators to develop an efficient process for randomization notification, investigational drug ordering, and documentation.

When implementing workflow changes and modifying existing processes, the department of pharmacy should make an effort to analyze data to trend activities for continuous process improvement. The departmental leadership may modify dashboards or “scorecards” to integrate information specific to disaster management during the COVID-19 pandemic. Information generated from activities such as emergency response and code cart exchanges, order verification, sterile compounding, drug procurement, ADC turnover and stock-outs, medication regimen complexity scoring, clinical interventions, and safety incidents will be valuable in optimizing staffing and reallocating operational or clinical resources if necessary.^{26,27}

Functionalities of the EMR and business analytics can be leveraged to monitor and trend prescribing patterns to identify opportunities for therapeutic interventions, forecast upcoming usage for better inventory management, and implement cost-avoidance strategies.

Medications purchased specifically for the management of patients with COVID-19 can also be tracked to generate real-time budget variance reports for financial stakeholders and the hospital leadership to maintain fiscal awareness.

Staff education and team management. Department of pharmacy personnel are essential for safe, effective, and timely pharmaceutical care during the COVID-19 pandemic. Thus, it is key to provide knowledge and resources necessary for staff safety and protection during performance of patient care duties. Staff education regarding institutional procedures

should be implemented as soon as possible; this includes educating personnel about proper hand hygiene and other infection control strategies, social distancing recommendations, removal and disposal of PPE, and hospital-approved PPE conservation measures, as well as outlining scenarios that require specific types of PPE. The staff should be provided with official procedures developed by the institution's human resources department, employee health services personnel, and/or the department of health regarding asymptomatic and symptomatic employees, potential exposure, testing availability, and return-to-work procedures.

In lieu of in-person meetings, conference calls and virtual huddles may become the preferred method of disseminating information and clinical updates in a timely fashion. Pharmacy department leaders can consider scheduling these sessions at routine intervals so that staff members can plan appropriately, with additional ad hoc meetings held as needed. Huddles may need to be repeated or recorded to ensure that all shifts and departmental areas are included. The choice of communication platform may vary with the institution's or department's subscription offerings. The use of secure messaging software can be optimized to promote team communication and smooth patient handoffs for optimal care coordination and continuity. Prior to implementation of new communication platforms, the department of pharmacy should assess whether software programs are compliant with Health Insurance Portability and Accountability Act (HIPAA) privacy and confidentiality requirements.

In light of the highly contagious nature of SARS-CoV-2, remote work by eligible pharmacy staff can be explored as a way to reduce the risk of virus exposure. Pharmacists can remotely participate in medication order verification, deliver many of the aforementioned clinical pharmacy services, partake in table rounds to discuss admitted patients, and provide

pharmacy informatics support. Administrators, administrative assistants, compliance and regulatory specialists, and members of supply chain teams and teams responsible for managing 340B Drug Pricing Program participation who are not physically involved in distribution may also be considered. Rotation schedules for remote work should be discussed and agreed upon in advance and readily available for staff to reference in case an individual must be contacted. Procedures should be implemented in compliance with hospital policies regarding remote work, as well as state board of pharmacy regulations or exemptions regarding remote patient care duties and order verification, while also ensuring that staff members have the necessary technology, remote-access virtual private network connectivity, and readily available resources for adequate communication and completion of assigned tasks. The departmental leadership can track dashboard metrics and documentation to ensure that productivity and the quality of comprehensive pharmacy services are not negatively impacted by remote work.

During crises, staffing shortages may be expected, and the department of pharmacy may have to operate with reduced personnel levels. The pharmacy leadership and staff should secure a mutual agreement and understanding that any member may be pulled from routine responsibilities to fulfill necessary operating requirements. Promoting flexibility and adaptability of staff members is vital during the COVID-19 pandemic; this may involve a decentralized pharmacist performing centralized pharmacist duties (or vice versa), a pharmacy administrator stepping in to perform direct patient care duties, a pharmacist substituting for a pharmacy technician, etc. These discussions may include policies and procedures as they relate to essential staff, overtime, and paid time off during the public health emergency. Major changes in staffing plans and departmental functions that indirectly or directly affect patient

care should be immediately communicated to providers on affected services. The department of pharmacy may work with human resources personnel to seek volunteers from various national and local networks, such as the Medical Reserve Corps or state pharmacy organizations. Selected volunteers should undergo required credentialing processes, training, and other compliance measures, as outlined by institutional policies. Normal onboarding procedures may not be feasible, but condensed orientations conducted with targeted checklists can be considered on the basis of departmental and hospital leadership assessments.

Expansion of pharmacy services. Health-system pharmacists can be positioned to provide additional services to improve patient care as part of the COVID-19 response. The federal Office of the Assistant Secretary for Health issued guidance from the US Department of Health and Human Services (HHS) to authorize pharmacists to order and administer point-of-care testing for SARS-CoV-2 for the duration of the public health emergency.²⁸ The department of pharmacy may collaborate with providers, nurses, and the hospital leadership to discuss deployment of available pharmacists to on-site, affiliated off-site, or drive-through testing stations to bolster community testing efforts. Pharmacists should be educated on proper testing and PPE procedures through institution-approved training sessions or documents. Before proceeding, sites should confirm state-specific laws or regulations surrounding point-of-care testing by licensed pharmacists. Pharmacists, and pharmacy interns with proper oversight, can also assist with communication of SARS-CoV-2 culture results to patients.

With the call to reduce in-person interactions, there has been an invigorated interest in expansion of telehealth and telemedicine services. Ambulatory care and transitions of care pharmacists can identify patients discharged after treatment for COVID-19 who are at high risk

for readmission (or receive referrals directly from partnering providers) and establish pharmacist-patient telehealth appointments. Pharmacotherapy assessments, patient counseling and education, medication therapy management, and collaborative drug therapy management (if applicable) can be performed via telehealth. New treatments may have been initiated during an admission for COVID-19, and a postdischarge telehealth visit will allow pharmacists to also follow up to ensure appropriate duration of therapy and detection of adverse effects. Many telehealth platforms are already compliant with HIPAA requirements, and the HHS Office for Civil Rights has issued a notification of enforcement discretion regarding provision of telehealth services using noncompliant platforms during the public health emergency.²⁹ Pharmacists participating in the aforementioned telehealth services should determine proper billing and reimbursement procedures as necessary.

Lessons learned. For the University Hospital of Brooklyn at SUNY Downstate Health Sciences University, receiving the COVID-19–only designation meant having to quickly prepare the institution and Department of Pharmacy for the incoming case surge while also being able to exercise change management skills to adapt to the evolving situation, which came with its unique challenges. One of the most prominent issues was the national shortage of PPE supplies, specifically those used by clinical pharmacists in critical care areas, operational pharmacists in sterile and hazardous product compounding, and pharmacy technicians performing ADC restocking and crash cart exchanges. By proactively projecting daily and weekly numbers for expected staff PPE usage, we were able to communicate frequently with our central sterile supply distribution team for allocation purposes. These estimates were based on in-person staffing schedules and shifts; the expected numbers of trips needed for medication restocking,

crash cart exchanges, and emergency responses; and guidance from the institution regarding PPE conservation strategies. We also collaborated with clinicians to modify standard medication administration times for various drugs to minimize nursing staff virus exposure and to preserve PPE supplies.

Given the expansion of intensive care unit capacity and unit bed counts, our pharmacists with expertise in critical care medicine were contacted frequently by providers, nurses, and fellow pharmacists without formal training in critical care medicine. A major challenge was being able to field and triage these patient-specific requests in a timely manner. Thus, we created guidelines for use of common critical care medications, including guidance on dose titration of continuous-infusion medications (ie, vasopressors, sedatives, opioids, neuromuscular blocking agents) and anticoagulation therapy in critically ill patients in the setting of COVID-19. Intensive care areas were impacted the most by critical drug shortages. Clinical pharmacists assisted with quickly transitioning our most frequently used sedative, opioid, and neuromuscular blocker infusions to less frequently used or rarely used alternatives while optimizing the use of adjunctive pharmacotherapies for pain, agitation, and sedation. This process involved significant provider, nurse, and pharmacist education and work by our pharmacy informaticists to ensure that drug information in the EMR for these agents was updated and relevant.

The operational pharmacy workflow changed considerably, with significant increases in labor-intensive tasks such as sterile compounding, restocking of ADCs, and exchanging of crash carts and emergency kits. The scenario was complicated by the absence of numerous staff on sick leave for mandatory self-quarantines due to SARS-CoV-2 exposure. Several mitigation

strategies were immediately enacted. First, with the closing of various outpatient clinics, ambulatory surgery centers, and infusion suites, staff were redeployed to the inpatient pharmacy or reassigned to clinical COVID-19 teams. Second, operational pharmacists agreed to step into pharmacy technician roles as needed during technician staffing shortages. Third, clinical pharmacists assumed a significant portion of order verification responsibilities through reassignment to decentralized services or remote work, allowing operational staff more time to attend to labor-intensive tasks. Finally, we coordinated with our human resources colleagues and the credentialing office to fast-track and onboard volunteers, who proved to be of great assistance during the peak of the pandemic.

Summary. The COVID-19 pandemic presents numerous challenges for hospitals and departments to maintain operations necessary for patient care delivery. Comprehensive pharmacy and medication management services are still needed to promote safe and cost-effective drug utilization during the public health crisis. Areas of focus include provision of operational services, clinical services, drug shortage strategies, informatics support, and team management. Opportunities for expansion of services during the pandemic include pharmacist-initiated point-of-care testing and telehealth services. Although it may be difficult to predict the exact time and extent of a COVID-19 surge in different areas of the United States, departments of pharmacy may implement preparedness plans and best practices in conjunction with providers, hospital leaderships, and other departments to serve the needs of their patients and healthcare colleagues.

References

1. Watson KE, Singleton JA, Tippet V, Nissen LM. Defining pharmacists' roles in disasters: a Delphi study. *PLoS One*. 2019;14:e0227132.
2. Melin K, Maldonado WT, Lopez-Cnadales A. Lessons learned from Hurricane Maria: pharmacists' perspective. *Ann Pharmacother*. 2018;52:493-494.
3. McGugan M. Hurricane Harvey and pharmacy's call to action. *Am J Health-Syst Pharm*. 2017;74:1820-1821.
4. Ford H, von Waldner T, Perri M 3rd. Pharmacists' roles in post-September 11th disasters: a content analysis of pharmacy literature. *J Pharm Pract*. 2014;27:350-357.
5. Traynor K. New Jersey hospitals come through during Hurricane Sandy. *Am J Health-Syst Pharm*. 2012;69:2120-2122.
6. Hogue MD, Hogue HB, Lander RD et al. The nontraditional roles of pharmacists after Hurricane Katrina: process description and lessons learned. *Public Health Rep*. 2009;124:217-223.
7. Velazquez L, Dallas S, Rose L, et al. A PHS pharmacist team's response to Hurricane Katrina. *Am J Health-Syst Pharm*. 2006;63:1332-1335.
8. Pincock LL, Montello MJ, Tarosky MJ, et al. Pharmacist readiness roles for emergency preparedness. *Am J Health-Syst Pharm*. 2011;68:620-623.
9. Bell C, Daniel S. Pharmacy leader's role in hospital emergency preparedness planning. *Hosp Pharm*. 2014;49:398-404.
10. Alkhalili M, Ma J, Grenier S. Defining roles for pharmacy personnel in disaster response and emergency preparedness. *Disaster Med Public Health Prep*. 2017;11:496-504.

11. Jenkins A, Rowe E, Granko R, et al. Effects of a new sterile product preparation and delivery process on operational efficiency and cost. *Am J Health-Syst Pharm*. 2010;67:1645-1649.
12. Abbasi G, Gay E. Impact of sterile compounding batch frequency on pharmaceutical waste. *Hosp Pharm*. 2017;52:60-64.
13. United States Pharmacopeia. General chapter <797> pharmaceutical compounding – sterile preparations. <https://www.usp.org/compounding/general-chapter-797>. Published 2008. Accessed May 12, 2020.
14. Granko RP, Poppe LB, Savage SW, et al. Method to determine allocation of clinical pharmacist resources. *Am J Health-Syst Pharm*. 2012;69:1398-1404.
15. Lee H, Ryu K, Sohn Y, et al. Impact on patient outcomes of pharmacist participation in multidisciplinary critical care teams: a systematic review and meta-analysis. *Crit Care Med*. 2019;47:1243-1250.
16. Morgan SR, Acquisto NM, Coralic Z, et al. Clinical pharmacy services in the emergency department. *Am J Emerg Med*. 2018;36:1727-1732.
17. Henneman A, Thornby KA, Rosario N, Latif J. Evaluation of pharmacy resident perceived impact of natural disaster on stress during pharmacy residency training. *Curr Pharm Teach Learn*. 2020;12:147-155.
18. Gwynn ME, Poisson MO, Waller JL, Newsome AS. Development and validation of a medication regimen complexity scoring tool for critically ill patients. *Am J Health-Syst Pharm*. 2019;76(suppl 2):S34-S40.

19. Newsome AS, Anderson D, Gwynn ME, Waller JL. Characterization of changes in medication complexity using a modified scoring tool. *Am J Health-Syst Pharm*. 2019;76(suppl 4):S92-S95.
20. Sanders JM, Monogue ML, Jodlowski TZ, Cutrell JB. Pharmacologic treatments for coronavirus disease 2019 (COVID-19): a review [published online ahead of print April 13, 2020]. *JAMA*. doi:10.1001/jama.2020.6019.
21. Alexander GC, Qato DM. Ensuring access to medications in the US during the COVID-19 pandemic [published online ahead of print April 9, 2020]. *JAMA*. doi:10.1001/jama.2020.6016.
22. Fox ER, Sweet BV, Jensen V. Drug shortages: a complex health care crisis. *Mayo Clin Proc*. 2014;89:361-373.
23. Fox ER, McLaughlin MM. ASHP guidelines on managing drug product shortages. *Am J Health Syst Pharm*. 2018;75:1742-1750.
24. American Society of Health-System Pharmacists. ASHP statement of pharmacist's role in clinical informatics. *Am J Health-Syst Pharm*. 2016;73:410-413.
25. Strudwick G, Residorfer E, Warnock C, et al. Factors associated with barcode medication administration technology that contribute to patient safety: an integrative review. *J Nurs Care Qual*. 2018;33:79-85.
26. Kinney A, Bui Q, Hodding J, Le J. Pharmacy dashboard: an innovative process for pharmacy workload and productivity. *Hosp Pharm*. 2017;52:198-206.
27. Cassat S, Massey L, Buckingham S, et al. Development of health-system inpatient pharmacy clinical metrics. *Am J Health-Syst Pharm*. 2019;76:1958-1964.

28. Office of the Assistant Secretary for Health, US Department of Health and Human Services.

Guidance for licensed pharmacists, COVID-19 testing, and immunity under the PREP act.

<https://www.hhs.gov/sites/default/files/authorizing-licensed-pharmacists-to-order-and-administer-covid-19-tests.pdf>. Accessed May 12, 2020.

29. Office for Civil Rights, US Department of Health and Human Services. Notification of

enforcement discretion for telehealth remote communications during the COVID-19

nationwide public health emergency. [https://www.hhs.gov/hipaa/for-professionals/special-topics/emergency-preparedness/notification-enforcement-discretion-](https://www.hhs.gov/hipaa/for-professionals/special-topics/emergency-preparedness/notification-enforcement-discretion-telehealth/index.html)

[telehealth/index.html](https://www.hhs.gov/hipaa/for-professionals/special-topics/emergency-preparedness/notification-enforcement-discretion-telehealth/index.html). Accessed May 12, 2020.