

From natural disaster to pandemic: A health-system pharmacy rises to the challenge

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Purpose. This report describes a health-system pharmacy's response to a natural disaster while staff members simultaneously prepared for the coronavirus disease 2019 (COVID-19) pandemic. By detailing our experience, we hope to help other institutions that are current facing or could encounter similar crises.

Summary. In early March 2020, a tornado destroyed the health system's warehouse for storage of most clinical supplies, including personal protective equipment and fluids. The pharmacy purchasing team collaborated with suppliers and manufacturers to recover losses and establish alternative storage areas. Days later, the pharmacy department was forced to address the impending COVID-19 pandemic. Key elements of the COVID-19 response included reducing the potential for virus exposure for patients and staff; overcoming challenges in sourcing of staff, personal protective equipment, and medications; and changing care delivery practices to maintain high-quality patient care while maximizing social distancing. The pharmacy department also created distance learning opportunities for 70 pharmacy students on rotations. After an initial plan, ongoing needs include adjustment in patient care activities if significant staff losses occur, when and how to resume clinical activities, and how to best utilize the resources accumulated. Elements of practice changes implemented to reduce COVID-19 threats to patients and pharmacy personnel have proven beneficial and will be further evaluated for potential continuation.

Conclusion. The pharmacy department's efforts to respond to a natural disaster and unprecedented pandemic have proven successful to this point and have illuminated several lessons, including the necessity of cohesive department communication, staff flexibility, prioritization of teamwork, and external collaboration.

Keywords: COVID-19; disaster medicine; pharmacy service, hospital

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The disease outbreak caused by SARS-CoV-2 (severe acute respiratory distress novel coronavirus 2) was first reported in Wuhan, China, in December 2019 and rapidly spread throughout the world, leading to the current coronavirus disease 2019 (COVID-19) pandemic.¹ The United States leads the world in numbers of confirmed cases and deaths.² In a crisis situation like the COVID-19 pandemic, a health-system pharmacy department must respond quickly to maintain functionality and meet emerging needs. At Vanderbilt University Medical Center (VUMC), a

large tertiary academic health system, weeks before the COVID-19 pandemic was declared a tornado demolished a shared administrative and distribution center holding much of the medical center's clinical supplies. The compounded injury of a natural disaster followed by a rapidly growing pandemic required a collaborative, innovative, and flexible team effort across all pharmacy areas and the entire medical center to maintain high-quality patient care.

The aim of this report is to describe a health-system pharmacy-wide response in recovering from a natural

disaster and preparing for COVID-19. By detailing our experience and efforts, we hope to help other institutions that are or will be in a similar disaster response mode.

Activating disaster response mode

In the early hours of March 3, 2020, a powerful tornado struck middle Tennessee, causing a devastating loss of lives, homes, and businesses. VUMC did not sustain structural damage; however, the warehouse storing most clinical supplies and supply chain offices was largely destroyed. The VUMC department of emergency preparedness responded by activating the medical center's emergency operations center, which is responsible for creating and implementing an incident action plan for various elements of disaster response. This center is composed of members of the VUMC leadership, who acquire the following roles: incident commander, logistics officer, operations officer, planning officer, finance officer, liaison officer, public information officer, information management officer, chief physician officer, safety officer, and security officer. Together, the emergency operations center team outlines the impact of the incident on medical center operations, develops and implements solutions, and communicates response strategies to employees.

Tornado's impact on the medical center

Most VUMC patient care supplies (personal protective equipment [PPE], intravenous fluids and lines, gowns, hand sanitizer, gloves, etc) are sourced from and stored by Illinois-based Medline Industries, Inc., which manufacturers and/or contracts with supply manufacturers to procure necessary items for the hospital. A daily order for hospital and pharmacy supplies is submitted to Medline, resulting in shipment of necessary items later the same day. Onsite Medline storage areas and the VUMC supply chain department are housed in the same building, which was heavily damaged by the tornado,

KEY POINTS

- Significant loss of medical center supplies and pharmacy storage areas due to a natural disaster required rapid sourcing of supplies and medications necessary to prepare for patient care challenges related to the COVID-19 pandemic.
- Key COVID-19 response elements included reducing staff and patient exposure threats; staff redeployment and staffing modifications; sourcing of personal protective equipment and medication supplies; and adjusting pharmacy practices to maintain quality patient care.
- Addressing complex disaster response scenarios requires communication, staff flexibility, teamwork, and collaboration.

eliminating the facility as a distribution center for VUMC. To continue to meet patient care needs, the pharmacy purchasing and supply chain teams were forced to quickly transition to and/or establish alternative channels to access supplies directly from manufacturers and identify an area to serve as a new distribution center for storage and delivery of supplies.

The loss of Medline services crippled VUMC and created a challenging environment for accessing patient care supplies. However, the pharmacy purchasing team worked diligently with manufacturers to maintain uninterrupted services to the hospital.

Though devastating, the tornado provided an impetus for VUMC to go into disaster response mode, which proved crucial when, 8 days later, COVID-19 became an all-consuming focus. Our ability to prepare for the COVID-19 pandemic was catalyzed by an activated emergency operations center, preexisting relationships with

suppliers and manufacturers and prompt development of alternative storage areas.

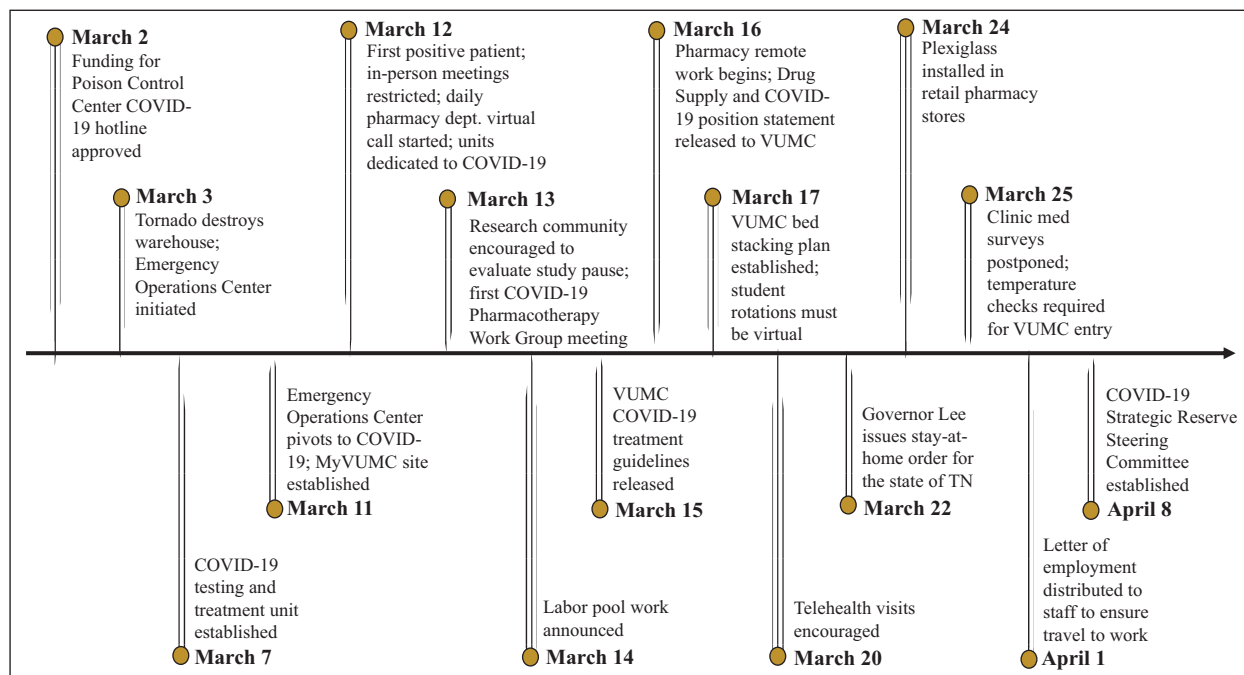
Transition to pandemic response

Eight days after the tornado (ie, on March 11, 2020), the emergency operations center transitioned to preparing for the approaching COVID-19 pandemic. Figure 1 illustrates a brief timeline of key VUMC disaster response events. A temporary testing and treatment site (Figure 2, panel A) was created on the second floor of an employee parking garage. To supply medication to this new unit, the central pharmacy staff filled 2 tackle boxes with medications and fluids; these were labeled "mobile medication supply" (Figure 2, panel B).

The VUMC executive leadership called on the pharmacy department to develop a plan to maintain patient care in a worst-case scenario, detailing medications and supplies required to meet the needs of a full-capacity hospital (1,100 beds), with up to 300 SARS-CoV-2-positive intensive care unit (ICU) patients. The pharmacy leadership reached out to colleagues across the country at institutions already affected by COVID-19, who shared medication lists and recommendations for preparation that guided the inpatient pharmacy response. VUMC pharmacy leaders began to condense satellite pharmacy operations to a central location. Outpatient pharmacies implemented safer operations to meet patient demand while protecting staff members. The VUMC-affiliated Monroe Carell Jr. Children's Hospital strategized to offer additional bed capacity support and cross-training of its staff for deployment at the adult hospital.

As the month of March passed, leaders from across the health system and the pharmacy department quickly developed and implemented methods to protect personnel and maintain patient care. To stay abreast of intradepartmental and VUMC-wide efforts, a daily virtual conference call

Figure 1. Timeline of key events related to the Vanderbilt University Medical Center (VUMC) pharmacy department's response to tornado damage and the coronavirus disease 2019 (COVID-19) pandemic.



including all pharmacy managers and directors was initiated. Key elements of the response are detailed below.

Key elements of response

Reducing COVID-19 exposure risk. At present, the primary method of reducing COVID-19 spread is to avoid or reduce contact with infected individuals, which is a challenge given the high rate of asymptomatic transmission.³ Social distancing has proven effective in reducing transmission.^{4,5} Beginning in mid-March, multiple methods to reduce potential staff and patient exposure to SARS-CoV-2 were implemented.

Alternative work agreements were developed to enable staff members to work remotely. Employees considered to be at high risk for contracting or complications from contracting SARS-CoV-2 were removed from direct patient care areas. Options for staff members with a “high-risk exemption” (a policy measure allowing them to continue receiving full pay) included working in non-direct patient care areas within their respective departments or in other

areas via the labor pool (as described below), remote work, and pausing work in some cases. On March 19, a state executive order allowed pharmacists and pharmacy technicians to work at alternative locations, further enabling remote work from retail and specialty call centers.⁶ Managers developed methods to monitor staff productivity, and all remote workers were expected to be available to come onsite at intervals deemed appropriate by departmental leaderships. Resources required for work completion were taken home by employees and some new resources required purchasing, which proved challenging due to market demands (Table 1).

On-site work environment changes were made to reduce staff and patient exposure to SARS-CoV-2. Staff members were disbursed to empty work stations, and social distancing was enforced. Hand-sanitizing stations were installed in pharmacy areas that lacked them, and schedules for cleaning within pharmacy areas before, during, and after shifts were established. In retail pharmacies, limits on the number

of patients allowed to wait in lobby areas were established, and 6-foot distances were marked on the floors to separate those waiting. Plexiglass dividers were installed in all outpatient pharmacies. Masks were used for routine vaccine administration. Monthly clinic medication integrity surveys for all 205 clinics within the VUMC health system were suspended following Tennessee Board of Pharmacy approval. In-patient rounds were switched to virtual formats.

Pharmacy technicians clustered medication floor delivery schedules and optimized automated dispensing cabinet storage using a new cart stocked with cleaning wipes, gloves, and masks. COVID-19 crash carts with essential resuscitation medications were created to help conserve medications by preventing them from being exposed to virus and thus having to be discarded. Patient counseling (in-patient and “meds-to-beds”) was done from hospital-supplied ipads to patients’ smartphones. A pharmacist dedicated to managing hypertension

Figure 2. One of the first efforts in response to the coronavirus disease 2019 (COVID-19) pandemic was establishing a testing and temporary treatment site for patients with suspected COVID-19 (panel A). Built within the employee parking garage, this unit was quickly supplied with necessary medications from the emergency department packed in tackle boxes (panel B).



in a local barbershop setting⁷ began using telehealth visits for patient monitoring and interventions.

Internal resource redistribution. Substantial efforts were directed towards managing the staff, PPE, and medications. Staff redeployments were necessary to best utilize VUMC's essential human resources. The VUMC emergency operations center created a labor pool composed of high-risk staff members considered to be at high risk for having been exposed to SARS-CoV-2 and needing to work in low-risk areas.

The pharmacy department utilized nonpharmacist staff members from the labor pool to assist with medication purchasing and organization and patient phone calls. Outpatient pharmacies shifted many of their front-line employees to the retail central pharmacy to manage increased numbers of patients receiving mail-order prescriptions. These staffing changes improved staff support and reduced the potential for burnout.

Having recently lost much of the health system's PPE supply due to the

tornado, the pharmacy department, in conjunction with VUMC's infection prevention department, implemented several changes to preserve PPE while maintaining patient and staff safety. The adult and children's hospitals consolidated the number of sterile product areas. The children's hospital batch-prepared hazardous medications and other sterile products. The clinic pharmacy limited compounding of sterile and nonsterile products for drug allergy testing to critical-need products only. The meds-to-beds discharge program

Table 1. Resources Needed for VUMC Pharmacy Staff Members' Transition to Remote Work

Resource(s)	Pharmacy Department(s)	Notes
Desktop, laptop, tablet computers	All	This equipment was used for remote work and patient counseling; most staff members used existing resources, but a few purchases were required.
VPN access	All	VPN installation on all remote work computers was required for access the health system's software.
New telephone lines	Specialty, retail	HIPAA-secured lines for patient calls were purchased, and software was installed on computers being taken home by staff members.
Credit card processing licenses	Specialty, retail	As more patients transitioned to mail-order services, additional staff members were required to collect credit card information; this required the purchase of additional licenses.
Electronic fax system	Specialty	Faxing is a frequent form of communication with insurers and manufacturers. The pharmacy leadership identified and implemented an electronic fax solution and provided an online training webinar for staff.
Ethernet cords	Specialty	The minimum home Internet speed required for remote work was set at 30 Mbps. A pharmacy technician in the call center donated 40 Ethernet cords to facilitate hard-wire Internet connections to reach this speed on the VPN.
USB headsets	Specialty	Headsets required for VoIP phone applications were difficult to procure. The team procured adapters (USB to 3.5 mm) to enable the use of personal headphones.

Abbreviation: HIPAA, Health Insurance Portability and Accountability Act; USB, universal serial bus; VPN, virtual private network; VoIP, voice over Internet protocol.

stopped bedside delivery to patients in isolation. Staff members were no longer required to wear PPE in rooms of patient at low risk for infection or colonization with methicillin-resistant *Staphylococcus aureus* or vancomycin-resistant enterococci, per guidance from VUMC infection control.

Limited stocks of PPE at VUMC's usual suppliers forced creativity: Pharmacy personnel found gloves for frontline workers performing nonsterile tasks at local home and office supply stores. Additional hand sanitizer was obtained from a local compounding pharmacy and local distilleries as well as VUMC's contracted 503B pharmacy. The medical center issued guidance on reusing gowns and masks. Pharmacy staff members involved in sterile and nonsterile compounding were asked to reuse unsoiled and intact masks and disposable gowns for the duration of their work shift. Masks and gowns were marked with a staff member's initials; masks were stored in paper bags for reuse. Reuse of gowns used

for high-risk compounding was not allowed under any circumstances. PPE supplies were donated from supporters across the state, including Lipscomb University College of Pharmacy, US Air Force Recruitment Services, local investment and legal firms, local boutiques, a construction company, and country music artists. These collective efforts successfully built a stock of PPE for hospital-wide use.

Anticipating the need to treat a growing number of patients with COVID-19, the pharmacy leadership built a strategic supply of medications. We first performed a needs assessment to identify medications required for treatment of patients with COVID-19 and ensure medication access for all other patients. Several groups contributed to developing this list. The adult and children's hospitals, outpatient and clinic pharmacies, and physicians communicated regarding which medications were already in short supply or were needed in caring for ICU patients. A new established COVID-19

pharmacotherapy working group recommended potential COVID-19 treatments. Finally, the pharmacy purchasing team reviewed medications sourced solely from China and/or India that might be difficult to procure. Medication products of most concern during this time were inhalers, sedatives, paralytics, opioid infusions, anti-inflammatories, and hydroxychloroquine (which has since become less utilized). Once a list was developed, we needed to better understand the quantities of medications to obtain. Leaders from the clinical and management teams collaborated to calculate medication quantities to order based on normal doses and anticipated patient volumes.

The normal medication and supply purchasing paradigm was uprooted by the tornado, forcing the pharmacy purchasing team to explore all potential supply chain avenues. The team obtained medications from wholesalers when possible and established or used preexisting direct accounts with

manufacturers to obtain out-of-stock medications from wholesalers. As some of the needed medications were controlled substances, the purchasing team worked with local vendor contacts to complete necessary forms and applications to access these medications. The purchasing team frequently communicated with wholesalers and manufacturers to ensure that necessary medications were obtained in a timely manner or alternate routes of obtaining out-of-stock therapies were found. During the procurement process VUMC conversed with manufacturers and wholesalers to help ensure that institutions in other areas of the country currently fighting the pandemic had sufficient resources. The team used a procurement inventory management tool to identify current stock and ongoing needs.

Finally, a virtual dashboard was created to clearly communicate current strategic supply inventory and needs based on previously developed simulations of potential patient scenarios and historical and anticipated utilization rates. Medications and supplies procured for the COVID-19 strategic supply are stored and inventoried separately from all other hospital stock. The pharmacy department created a strategic reserve steering committee to communicate a cohesive daily message regarding medication supplies at the medical center.

Providing patient care for COVID-19 and other populations. Treating all VUMC patients, regardless of COVID-19 status, remained of the utmost importance. The COVID-19 pharmacotherapy working group, composed of researchers, infectious diseases (ID) clinicians, virologists, and ID pharmacists reviewed available literature, discussed market availability of chronic disease state therapies, and provided initial treatment recommendations within 24 hours of the executive leadership's initial request. Subsequently, a daily videoconference meeting was established to review and incorporate new data and guidelines. This workgroup was expanded to include hematology/oncology, rheumatology, and critical care

providers as immunomodulatory therapies and convalescent plasma emerged as treatment options. Treatment recommendations from the group are published weekly on VUMC's intranet. An email is generated to notify medical center staff when the recommendations are updated. The group also provides guidance on other topics related to COVID-19, such as concomitant medication use and utility of laboratory tests.

Health informatics personnel expeditiously implemented decision support in the electronic medical record to provide guidance on dosing and duration of hydroxychloroquine and tocilizumab therapy, along with prompts to discourage inappropriate prescribing practices. Due to the limited supply and high cost of certain medications, a novel pharmacy, therapeutics, and diagnostics committee approval pathway was developed. Requests for use of tocilizumab are reviewed by a group of ID, hematology/oncology, rheumatology, critical care, and pharmacy representatives. The collegial nature of this group fostered further cross-specialty communication in the rapidly changing patient care and medication-use climate.

The investigational drug services (IDS) team recognized the challenges of continuing to ensure treatment for existing patients in over 500 ongoing studies while initiating new drug studies focused on COVID-19. Though many clinical trials were paused, continuation of studies of investigational treatments was encouraged. The IDS team quickly developed a plan for shipping medications (previously nonexistent) and obtained guidance from the legal department on shipping medications out of Tennessee. As storage allowed, the team worked to increase on-hand inventory to provide patients with an additional month's supply (subject to approval by the trial sponsor and patient care providers). IDS personnel cross-trained central pharmacy personnel to facilitate enrollment in clinical trials. All IDS activities were documented in memos sent to the research leadership.

VUMC quickly became a site of interest for COVID-19 studies,

facilitated by the IDS team compounding hydroxychloroquine on-site. Two new COVID-19 studies were opened over the course of a few weeks, a process that typically takes months. Two additional studies opened in April 2020, with 3 more expected to start by the end of May 2020. The ingenious efforts of the IDS pharmacy team prevented lapses in treatment for current clinical trial patients and enabled VUMC participation in COVID-19 clinical trials.

Patients treated with specialty medications often require frequent monitoring to complete insurance requirements and ensure medication safety and effectiveness. Specialty pharmacists, in consultation with prescribing providers, appealed to payers to waive monitoring requirements for stable patients in cases in which that was safe and appropriate. When needed, specialty pharmacists facilitated completion of monitoring requirements at locations closer to patients' homes. The specialty pharmacy collaborated with prescribing providers to develop guidance for patients receiving biologics who were at risk for COVID-19 acquisition due to immunosuppression so that providers could advise them to suspend therapy if necessary. Additionally, as clinics closed, specialty pharmacists coordinated many patients' transition from infusions to self-administered medications and, in some cases, obtained insurance approval for patients to either fill a 90-day supply of medication or obtain early refills.

Student activity

Several local hospitals began cancelling student pharmacist rotations in January and February. On March 12, VUMC restricted its 70 pharmacy students from participating in clinical activities involving a risk of exposure to patients with known or suspected COVID-19. Soon after, the VUMC office of graduate medical education suspended all student participation in clinical activities. The pharmacy education program manager coordinated with preceptors and students to transition to virtual rotations for the remainder of March, allowing existing students

to complete graduation requirements. Subsequent rotations are being offered virtually when possible or rescheduled based on preceptor availability.

VUMC has also engaged students from local schools of pharmacy to volunteer for staffing of the poison control center COVID hotline. Fifteen students were anticipated to participate in this opportunity every week through the end of June. Though a reduction in clinical activity poses significant challenges, innovative methods to engage students and provide educational experiences are being developed and shared across several national pharmacy platforms.

Looking forward

COVID-19 strategic planning continues, as the duration of the pandemic is unknown. A significant loss of staff would strain an already exhausted workforce, forcing the VUMC leadership to consider how to adjust practices to continue to provide excellent patient care. The inpatient pharmacy department has proposed collapsing services from a decentralized model to a centralized model of inpatient operations. The department would absorb staff members from other parts of the enterprise and deploy pharmacy residents and pharmacy interns. The remote practice has been successful for many staff members in the short term; when and how they are brought back on-site must be carefully considered. The pharmacy management plans to meet and consider whether remote work will be prolonged, phased out, or implemented via hybrid models for certain roles within the department.

Increased staffing needs are anticipated as more medical center services are resumed. Clinics will likely experience a significant influx of patients for visits and infusion appointments; this will have a major impact on the operations of the clinic pharmacy and inform our strategy in bringing staff members back on site. We are developing a preliminary plan to implement a hoped-for COVID vaccine in addition to the seasonal influenza vaccine, which would

affect staffing needs. The specialty pharmacy anticipates an increased need for financial assistance services, as many patients will lose their primary insurance due to unemployment.

VUMC strategically procured medications and supplies to assist in the response to the COVID-19 pandemic. As we better understand the medical center's medication needs moving forward, we will adjust utilization to avoid unnecessary surpluses; however, items such as inhalers continue to be in demand and are anticipated to be difficult to procure. As projection models predict different peak times for a COVID-19 surge in the Nashville area, the pharmacy department is working closely with the hospital administration to predict different transition points (eg, resumption of elective surgeries, easing of bulk purchases for COVID-19-related items, closing of COVID-19 units). We anticipate the need for components of COVID-19 care to be present for an extended period and will frequently reassess needs to support patients and protect staff members and visitors.

Lessons learned

Several lessons for the VUMC department of pharmacy have emerged during the ongoing response to both a natural disaster and a pandemic. The full impact of our preparation is yet to be seen; however, we offer the following recommendations that have been key in this preparation phase.

Communication. A cohesive response from all areas of the pharmacy department is necessary to optimize preparedness. We recommend having a single source of communication for the entire department. We utilized the medical center disaster response website and mobile application, MyVUMC. Pharmacy staff were encouraged to download the app and refer to the website as the source of truth for all COVID-19-related information. Additionally, we recommend frequent virtual manager and director meetings, with use of a consistent agenda that is shared with attendees in real time. For COVID-19 leadership meetings, we recommend

addressing, at minimum, hospital census impact, relevant hospital-wide updates and communications, human resources updates (including issues such as remote work, childcare, and COVID-19 screening), occupational health (including issues such as SARS-CoV-2 testing and work exemptions), remote work, strategic supply, hospital safety, treatment guidelines, clinical trials, and area-specific information targeted to ambulatory care, inpatient, and retail pharmacy operations and investigational drug activities. Area leaders should then disseminate information to pharmacy team members in a manner appropriate for their respective areas. Methods for dissemination have included a shared cloud storage drive, Microsoft Teams (Microsoft Corporation, Redmond, WA), email, and a shared network folder.

Staff flexibility. As described above, several practice changes were necessary to reduce virus exposure risks and sustain patient care. Staff willingness and availability to take on different roles allowed for high-quality patient care to continue. To date, 1,338 VUMC employees have been cross-trained for new roles in the medical center to accommodate work-exemption requests, and several of these employees were acquired by the pharmacy department. Within the pharmacy, inpatient pharmacists were trained by the investigational drug department. Retail pharmacy technicians were moved and trained in mail order processing. Health-system pharmacies should identify areas of highest need and re-deploy staff members accordingly.

Teamwork. Pharmacy department leaders can easily be overwhelmed during this time of unknowns, constant change, and urgent issues. Coming together in a positive way to help wherever possible can ensure the needs of the entire department are met. Within VUMC's central pharmacy, managers and directors helped in complying with increased cleaning requirements, demonstrating solidarity with their team. Following the initial push for strategic supply acquisition, the purchasing team alternated in taking

days off to preserve mental stability and energy. Children's hospital managers created an "on-call" procedure enabling staff members to reach a manager any hour of the day. In all areas, staff members were treated to lunches to demonstrate appreciation. These gestures build comradery to sustain efforts through crises.

Collaboration. External collaboration and idea sharing is vital in responding to a disaster. Fortunately, several resources have been developed by national pharmacy associations, such as COVID-19 listservers, forums, and webinars wherein health systems can share their experiences and lessons learned. Additionally, connecting with colleagues across the country early on in response planning is key in understanding what needs to anticipate. We recommend researching, evaluating, and using these resources to facilitate an informed response.

Disaster response efforts over the last several months have challenged our pharmacy department in unprecedented ways, but the creativity, courage, and comradery demonstrated by each team member have built an

even stronger department, one capable of responding to the next challenge, whatever it may be.

Conclusion

Responding to a disaster and a surge in COVID-19 cases required multidisciplinary collaboration to protect staff members, obtain necessary resources for the medical center, and maintain patient care. Though tornado damage reduced basic supply stock and required development of new pharmacy storage areas and delivery mechanisms, an activated emergency response system and open communication with suppliers facilitated rapid response to the COVID-19 pandemic.

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