Emergency preparation and mitigation for COVID-19 response in an integrated pharmacy practice model

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Purpose. The purpose of this descriptive report is to share experiences in crisis response planning and risk mitigation at a university health system department of pharmacy with an integrated clinical practice model in the early months of the coronarvirus disease 2019 (COVID-19) pandemic.

Summary. The department of pharmacy's COVID-19 pandemic response included successful planning and implementation of measures to maintain pharmacy operations and minimize COVID-19 exposure of patients and staff. These measures included ensuring adequate personnel staffing using flexible staffing solutions, ongoing assessment of supply chain integrity, and continuation of integrated clinical pharmacy services 24/7 throughout the initial phase of the COVID-19 pandemic. Information technology (IT) and educational program modifications are also discussed.

Conclusion. This report describes successful crisis planning and risk mitigation in the setting of COVID-19, which was facilitated by the department of pharmacy's integrated clinical practice model. This model enabled uninterrupted personnel scheduling, supply chain integrity, continued provision of 24/7 integrated clinical services, adaptive use of IT tools, and continuation of educational programs. The experiences described may be instructive to other pharmacy departments in evaluating their response to the COVID-19 pandemic and in planning for similar pandemic or other emergency scenarios.

Keywords: clinical pharmacy service, COVID-19, emergency preparedness, pandemic, pharmacists, strategic planning

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In December 2019 a previously unidentified type of coronavirus emerged from Wuhan, China. By February 2020 it had spread to more than 25 countries and was officially named by the World Health Organization (WHO) as coronavirus disease 2019 (COVID-19).[1] On March 11, 2020, WHO characterized COVID-19 as a pandemic.[2] As of the original writing of this article in July 2020, there were more than 10 million worldwide cases (2.6 million US cases) and more than 500,000 worldwide deaths (more than 125,000 US deaths).[3] By mid-March, many departments of pharmacy across the United States were actively engaged in planning and mitigation of their response to the pandemic. As states began reopening phases with a "flattening of the curve" effect in May and June 2020, varying opinions regarding the pattern ahead for COVID-19 and the potential for another surge later in 2020 existed. At the time of article submission, a second surge had indeed occurred, as evidenced by reports from numerous sources of case counts of up to 50,000 new cases per day nationally. When this article was in revision in October 2020, there were almost 40 million worldwide cases (8.1 million US cases) and more than 1.1 million worldwide deaths (more than 200,000 US deaths).[4]

This article describes the strategic planning and mitigation efforts by the Department of Pharmacy at the University of Tennessee Medical Center

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(UTMC) in Knoxville, Tennessee. Considerations of personnel scheduling, supply chain integrity, continued provision of 24/7 clinical services, information technology (IT), and continuation of educational programs are discussed. Although the local caseload may differ from other parts of the country and the specific integrated clinical practice model may contrast with other health systems, the UTMC Department of Pharmacy (UTDOP) hopes the gained experience may be helpful as other departments evaluate their response to COVID-19, currently and if a similar pandemic or emergency scenario occurs.

KEY POINTS

- This article describes strategic planning and mitigation efforts for coronavirus disease 2019 (COVID-19) in an integrated 24/7 clinical pharmacy practice model.
- Considerations of personnel scheduling, supply chain integrity, continued provision of 24/7 integrated clinical services, information technology, and continuation of educational programs are discussed.
- Experiences described may be helpful as other departments evaluate their response to COVID-19 both currently and if a similar pandemic or emergency scenario should occur.

UTMC and departmental overview

UTMC is a 700-bed tertiary care teaching hospital and is the region's only academic medical center. UT Graduate School of Medicine and UT College of Pharmacy have satellite campuses at UTMC; UTDOP serves as a major training site for UT College of Pharmacy, but most student rotations were suspended statewide in late March 2020. UTMC is a level 1 trauma center and has 7 centers of excellence (brain and spine; cancer; emergency and trauma; heart, lung, and vascular; orthopedics; primary care collaborative; and women and infants).

UTDOP provides integrated, decentralized clinical pharmacy services 24/7 through 16 day shift decentralized teams, 7 evening decentralized teams, an inpatient pharmacy, a *United States Pharmacopeia* chapter 800–compliant parenteral products room, 3 satellite pharmacies, an outpatient and specialty pharmacy, and pharmacists practicing in ambulatory clinics in family medicine, heart failure, renal transplant, and cystic fibrosis. UTDOP also has a medication safety, 340B Drug Discount Program, and clinical IT offices. Clinical pharmacists and clinical pharmacist specialists work with decentralized certified pharmacy technicians to provide patient care. Technicians are critical in the distributive process, which heavily utilizes integrated computer medication cabinets (Omnicell, Mountain View, CA), sterile product and unit-dose preparation, and medication admission histories. There are 11 interdisciplinary rounding teams that pharmacists participate in daily. UTMC also has postgraduate year 1 (PGY1) and postgraduate year 2 (PGY2) pharmacy residents. These services are provided by 61 pharmacist full-time equivalents (FTEs), 6 college of pharmacy faculty, 14 pharmacy residents, 69 technician FTEs, and 7 support and administrative FTEs.

Clinical medication orders are received through Cerner clinical prescriber order entry (CPOE) systems (Med Manager and Powerchart; Cerner Corporation, Denver, CO). After therapies are reviewed, verified medications are available to the nurses in Omnicell cabinets located at nursing units. Parenteral products that have limited stability or infrequently used items are sent from the main pharmacy. Pharmacists conduct daily therapeutic drug monitoring with pharmacy and therapeutics (P&T) committee authorization of renal drug adjustment, proactive and robust therapeutic interchange, and intravenous to oral conversion; provide clinical pharmacy drug consults; and actively participate in emergencies (eg, advanced cardiac life support response, code stroke alerts, code STEMI [ST-segment elevation myocardial infarction], and trauma alerts). Ensuring uninterrupted clinical coverage of the aforementioned responsibilities during COVID-19 was a priority for the department.

Hospital planning and UTDOP emergency planning task force

Early in the community COVID-19 response, UTMC and other area health systems enacted a no-visitor policy. All nonessential procedures and services were suspended to limit COVID-19 spread and to preserve personal protective equipment (PPE). UTMC instituted a COVID-19 testing tent outside the emergency department (ED), limited access to the medical center entrances, and utilized engineering controls (negative pressure floors and rooms) for patients testing positive for or suspected of having COVID-19.

Within a week of the first reported COVID-19 case in Tennessee, UTDOP began reviewing a prior emergency planning document originally prepared in the wake of the 2009 H1N1 pandemic. The document focused mainly on staffing contingencies and remote order verification capabilities. Due to the expansion of multiple clinical teams on all shifts and IT enhancements that has occurred since 2009, the original plan has been extensively revised. Communication from the Tennessee Board of Pharmacy with linked references was received within the week of the WHO declaration of a pandemic, which gave recommendations from CriticalPoint (Gaithersburg, MD), US Food and Drug Administration, and USP to address guidance and informed recommendations on sterile products, PPE, and other potential shortages. This was in addition to ongoing emergency

preparedness planning with active involvement in the health systems' hospital incident command system as per Federal Emergency Management Agency and required biannual disaster exercises per Joint Commission guidelines. Despite this proactive stance, no one could predict the unprecedented speed and impact of the COVID-19 pandemic.

The UTDOP Patient Care and Quality Improvement Committee designated a task force for emergency preparedness that coordinated efforts both within the department and with other departments involving issues related to medication therapy. The task force was chaired by the UTDOP assistant director (clinical manager) and included clinical pharmacists and clinical pharmacist specialists from critical care, emergency medicine, acute care, infectious disease, and IT, as well as the PGY1 residency program director and a pharmacy technician. The task force met daily in the initial 2 weeks of planning of scheduling and mitigation and then met ad hoc via Microsoft Teams (Microsoft Corporation, Redmond, WA).

The task force addressed the following components: pharmacist and technician staffing schedules to include telemedicine, supply chain (including intradepartmental PPE), P&T committee guidelines and therapeutic interchange authorizations to address issues arising from COVID-19, emergency code response, IT considerations, and training programs (including how to best utilize residents while ensuring training integrity). Additionally, the task force discussed metrics to assure that the quality and safety of patient care were not compromised while these services were modified.

As mentioned, the central feature of the pharmacy practice model at UTMC is the provision of integrated clinical pharmacy services 24/7.[5] This allowed much flexibility in providing services in the setting of quickly evolving and uncertain circumstances, with the goal of providing uninterrupted patient care, guaranteeing adequate personnel, maintaining a quarantined group of healthy providers to staff in the event of provider illness, and ensuring provision of training programs. This ability to maintain clinical services 24/7 with the UTDOP practice model was a key component in avoiding some potential challenges faced by other health systems utilizing traditional split model practices (eg, order review and clinical practice handled by separate pharmacists). Listserves and shared communications from early in the pandemic from other parts of the country stated that their clinical pharmacists had to work extra shifts[6]; with the integrated model, all pharmacists practice clinically, thus mitigating potential staffing challenges and practitioner burnout.

Pharmacists' practice modifications

One of the key priorities was ensuring consistent staffing levels in the setting of growing COVID-19 cases within the state. Scenarios considered ranged from full staffing to limited staffing due to illness. The UTDOP task force opted to utilize a scheduling block for pharmacists (2 weeks on-site and 2 weeks off-site quarantined via remote IT clinical system access). Each off-site team had a corresponding on-site partner team. The off-site teams were responsible for CPOE review, clinical consults, consults with interdisciplinary teams (using Microsoft Teams, PerfectServe [PerfectServe, Inc., Knoxville, TN], etc), review of home medications to assist with provider admission medication reconciliation, and daily therapeutic drug monitoring. The on-site team had the same responsibilities in addition to carrying service pagers for the off-site teams, carrying assigned code pagers, and taking care of needed on-site activities (eg, consents for home medication). Utilization of on-site and off-site block scheduling occurred during all shifts. Pharmacist presence on rounding interdisciplinary teams either in person (on-site) or virtually and via telemedicine (off-site) was coordinated with individual patient care teams.

Some pharmacists had responsibilities that could only be conducted on-site (eg, main inpatient pharmacy, parenteral products room, oncology pharmacy, and operating room pharmacy). Staffing contingencies for these positions were in place if one of the pharmacists became ill or required quarantine due to exposure. Plans included adjustments to integrated clinical decentralized teams and utilization of pharmacy residents in decentralized roles to allow for pharmacist reassignments, with pharmacy leaders covering these operational areas as needed. Off-site pharmacists, who were assigned to patient care or to administrative roles (eg, IT, medication safety, and drug policy), were required to be on-site within 1 hour to fill patient care teams if needed.

On-site quarantine strategies included beginning-of-shift staff huddles, departmental meetings, and educational presentations and conferences converted for Microsoft Teams to allow social distancing. Pharmacists participated remotely from their office, at patient care work areas, or from home if huddles occurred during their off-site remote work rotation. This began in March 2020 and continued at the time of publication.

Block scheduling was conducted for a 4-week period from the end of March through April 2020; after this time period, all patient care teams were brought on-site. The experience showed that, if needed, block scheduling could be effectively implemented as demonstrated in the metrics discussed below.

Metrics of pharmacists' activities during block scheduling

Given that Tennessee documented its first case of COVID-19 in mid-March 2020, April 2019 was chosen as the comparator month. Several metrics were selected and followed throughout the block scheduling process to ensure the standard level of patient care was maintained (Table 1).

As anticipated, based on the minimization of elective activities, there was a 30% decrease in the average

Table 1. Pharmacists' Metrics During COVID-19 Block Scheduling

Metric	April 2019	March 30–April 12, 2020	April 13–26, 2020
ADC	581.0	382.2	402.1
Order verification turnaround time, min			
Stat orders (target, 10 min)	8	9	7
NOW orders (target, 30 min)	9	8.5	8.5
Routine orders (target, <120 min)	17.0	13.5	12.5
Workload statistics			
Order action verifications	163,995	53,957	58,899
Doses dispensed	53,317	28,798	30,721
Interventions	1,259	494	406
Interventions per patient based on ADC	0.07	0.09	0.07
P&T committee–authorized management	2,548	971	1,283
P&T committee authorizations per patient based on ADC	0.15	0.18	0.23
Consults	639	211	220
Consults per patient per day based on ADC	0.04	0.04	0.04

Abbreviations: ADC, average daily census; P&T, pharmacy and therapeutics.

daily census. Throughout this period, order verification turnaround time remained within the acceptable time frames as defined by the institution. Monthly interventions, which are voluntarily documented by pharmacists, remained constant between these time frames. However, when adjusted for average daily census (ADC), there was a 28% increase in documented interventions during the first 2 weeks of block scheduling. Interventions during the second half of the block schedule were consistent with the comparator month. This initial increase could be attributed to the acuity of the patients during this period or to less time constraints given the decrease in student learners and the changes to patient rounding services during this time. P&T committee–authorized management of drug therapy also increased by 20% during the first part of block scheduling and 53% during the second part of the block schedule. Supply chain issues and the need for more therapeutic interchanges and specific interventions related to the COVID-19 population, including nebulizer to metered-dose inhaler (MDI) interchanges, and coordination of medication administration to limit entry into the COVID-19 patient rooms may be reasons for this increase in P&T committee–approved actions. Pharmacy consultation for the management of drug therapy remained constant when adjusted for ADC.

Supply chain integrity

While supply chain was a consistent concern before COVID-19, it became a critical focus during the pandemic. UTDOP investigation demonstrated that there were few answers regarding the supply chain and medications from a global resourcing aspect. This prompted exhaustive steps in minimizing crucial patient impact. UTDOP has a dedicated full-time pharmacy technician for medication procurement and contracting who greatly assisted in managing supply chain issues.

Exponential shipping volumes across multiple product lines also contributed to delays in obtaining supplies. At the onset of the COVID-19 pandemic, pharmacies began ordering medications not previously in high demand such as albuterol inhalers/MDIs and hydroxychloroquine. Wholesalers' just-in-time purchase inventories also contributed to order fulfilment issues. Almost overnight, all products began to have allocations based on historic usage or patient need. According to surveys by Premier Inc.,[6] increased use of medications to theoretically treat COVID-19, but also the possible adverse effects of agents used to treat COVID-19, occurred. For example, potential cardiovascular disease and arrhythmia treatments saw an increase in amiodarone usage. For UTMC, this was a significant issue as Baxter's (Deerfield, IL) premixed product was already on allocation. Data released in March 2020 from Premier Inc. showed shortages within the hospital setting in New York. Increases in use of up to 1,870% for albuterol, 786% for cisatracurium, and 4,100% for midazolam were notable examples.[8] Increased funneling of medications to hot spots further exacerbated the need to evaluate and adapt to available products.

Traditionally, UTDOP has worked rapidly with the P&T committee to mitigate potential drug shortages. This was beneficial given the challenges associated with COVID-19. P&T committee authorized restrictions for certain inpatient use (eg, the prescribing

of hydroxychloroquine [early in the pandemic] and remdesivir [as the pandemic evolved]) was limited to infectious disease or pulmonary and critical care providers), therapeutic interchanges on certain dosage forms (eg, albuterol nebulizers were converted to MDIs in nonventilated patients), and autoconversion of some agents to minimize the number of times the nurse would enter a patient room (eg, prophylactic subcutaneous heparin 3 times daily converted to enoxaparin daily if renal function appropriate).

Emergency department pharmacy presence and modifications

A screening tent was erected at the ED entrance for patients suspected of having COVID-19 to isolate and decrease the potential for COVID-19 exposure for staff and others. After initial evaluation at the tent, patients underwent COVID-19 testing and were discharged, or, if further workup was needed, patients were placed within a hot zone section of the ED. Within the hot zone, staff wore PPE, including N95 masks, surgical gowns or Tyvek suits, and face shields, to minimize the risk of transmission.

Since 2008, UTMC has had dedicated ED pharmacists who work the current coverage hours of 7 AM to 1 AM most days and other pharmacists available by pager 24/7. Part of the UTDOP mitigation planning augmented ED pharmacist staffing with the addition of extra weekend daytime coverage and remote CPOE order verification, anticipating increased volumes and/or acuity level of patients within the ED. ED pharmacists worked with ED leadership on optimizing utilization of pharmacy resources within the ED, including the hot zone, during this pandemic. Pharmacists remained outside of the hot zone, communicating via radios and telephones; however, they were prepared to don appropriate PPE for medical emergencies within the hot zone if needed. Rapid sequence intubation kits were redesigned for the hot zone to a bagged system to aid in the disposal of contaminated supplies while also allowing for sanitation to preserve medications that might be on limited allocation. To conserve PPE and limit the number of staff potentially exposed, pharmacists remained outside of the rooms (unless otherwise determined necessary) to prepare medications and to serve as a drug information resource during these critical patient situations. Furthermore, pharmacists also stocked the Omnicell drug cabinets to reduce additional personnel, foot traffic, and use of PPE within the isolation area.

Pharmacy technicians and drug distribution modifications

Modifications to technicians' standard workflow reduced potential exposure, helped the conservation of PPE, and ensured proper care for patients. In mid-March, medication history technicians were restricted from entry to rooms in the ED containing patients suspected of having COVID-19. In late March, technicians were restricted from entry to all patient rooms, and medication history technicians relocated to a remote work area. Technicians obtained information primarily through phone interviews with patients, family members, and external pharmacy database queries. One technician was physically located within the ED to aid in drug distribution and to be available to nurses and pharmacists. While this process was found to be functional, it was not deemed optimal. More rapid COVID-19 testing and enhanced patient isolation efficiency allowed return to the standard process. However, if the pandemic had again escalated and conditions had warranted, it would have provided a workable solution.

Potential technician burnout was a consideration due to potential quarantine scenarios. Although elective procedures were greatly reduced during the first 2 months of the pandemic, the decision to maintain a consistent structure was made because of the varying specialization of practices of technical staff (eg, medication histories, decentralized technicians, operating room, IV admixture, oncology, and narcotics) and the inability to perform their activities remotely. Consultation with human resources and IT was conducted, but a workable alternate plan mirroring the pharmacists' approach was not deemed feasible. The health system was also extremely fortunate that there were no layoffs or furloughs. Staff were required to take 8 hours of mandatory paid time off each week for approximately 2 months to offset decreased revenues.

Other modifications included the following:

- Entry into patient rooms was eliminated for visual verification of IV rates and remaining volumes. Technicians used electronic medication administration record summary in Cerner and direct communication with registered nurses to complete reports for parenteral admixture staff on future needs.
- Technician rounding times were consolidated to limit exposure. Evaluation of drug delivery to COVID-19 units also included assessing use of the pneumatic tube system. The safety and engineering departments were consulted in March 2020 on needed changes. The tube stations were in the central floor space of that building and all patient rooms were negative pressure; therefore, no changes were made to that process. The pneumatic tube station located in one specific area of the ED designated as a hot zone was sealed off. Due to the proximity of the area to the main pharmacy, medications could be delivered to adjacent areas with minimal delay.
- Storing of patients' home medications was modified for patients confirmed or suspected of having COVID-19. Nurses followed their usual process for inventorying medications and placed them in designated home medication bags. Pharmacy technicians then donned

gloves and placed the sealed home medication bags in large plastic bags. The outsides of the bags were sanitized and allowed appropriate dwell times based on the disinfecting product. The sealed bags were then stored in the appropriate home medication storage area.

- Medication waste from hot zones was bagged for disposal on the actual nursing units per institutional guidelines.
- Albuterol inhalers were dispensed only if it was a scheduled medication or as an as-needed medication if the nurse or registered respiratory therapist notified pharmacy that a dose was needed. After a risk-benefit analysis, it was decided that MDIs were to be kept in patient rooms to minimize room re-entry. Emergency response drugs were kept outside of patient rooms in a modified process established for all codes. Any code cart drawers, code boxes, or anesthesia intubation packs that were taken to a floor were cleaned before being brought into the pharmacy. Any medications that were in a COVID-19 patient room were discarded.
- Disinfectant wipes and proper PPE, including gloves, were provided for proper sanitation of surfaces, including delivery carts and bins. Viricidal wipes were used on Omnicell dispensing cabinets by pharmacy technicians and nurses.
- Rounding technicians were granted temporary access to surgery scrub dispensaries for a change of clothing for each shift.
- Implementation of CriticalPoint strategy occurred with PPE mask conservation policy and weekly surface sampling in sterile admixture areas.[4]

IT modifications

To disseminate the COVID-19 status on each patient, a testing status pop-up alert was developed within the Cerner system. If COVID-19 testing was ordered, 1 of 3 COVID-19 result alerts appeared in the system when the electronic chart was accessed. These included a positive COVID-19 test, a negative COVID-19 test, or a pending COVID-19 test. This allowed personnel to be aware of the possibility of COVID-19 positivity in their patients. Test results also "fired" an alert in the pharmacists' order verification system. This alert was helpful for personnel, considering the need to conserve PPE, in determining the appropriate medications and dosage routes and when responding to emergency codes.

While CPOE has been in place since 2012 (including remote access), a minimal amount of daily workflow remained on paper. This included the pharmacy's consult communications and the pharmacy's service "pass off" communication between shifts. To facilitate pharmacists' ability to remotely cover services, these forms were converted to an electronic format. Microsoft Office OneDrive (Microsoft Corporation, Redmond, WA) was selected to expedite this change. Multifactor authentication for Microsoft Office 365 (Microsoft Corporation, Redmond, WA) provided the task force confidence in protecting patients' data. OneDrive allowed a virtual folder for each patient floor. Within the folders, pharmacists documented patient consults and necessary shift-to-shift pass off information. After using this system during the block scheduling, UTDOP opted to continue it until a fully integrated electronic clinical documentation system could be adopted.

Resident educational training

In Spring 2020 the UTMC had 12 pharmacy residents (7 PGY1 residents; 3 PGY2 residents with 1 each in ambulatory care, critical care, and internal medicine; and 2 residents in a 24-month pharmacotherapy program). All residents, except 1, transitioned to a 2-week block schedule that ran the course of a month-long learning experience. (One previously scheduled for a 7-day on/7-day off rotation remained on that schedule.) During the block schedule month, every attempt was made to minimize any negative impact that the block schedule may have had on the resident's learning experience by having residents mirroring preceptors' block scheduling. This allowed for 2 weeks of face-to-face interaction with the preceptor on-site, in addition to 2 weeks of remote interaction in which technology was utilized extensively. Relying on web-based platforms, including Microsoft Teams, residents on the 2-week remote block continued to participate in patient care rounds and other clinical activities and to meet daily with preceptors.

In May 2020 an online survey was sent to the 11 pharmacy residents who were switched to a block schedule to assess the impact of the UTDOP COVID-19 response. Survey results were anonymous, and a 91% response rate was obtained. The survey results indicated that residents felt their personal learning on rotation was somewhat negatively affected by remote work compared with working in person, their impact on patient care was largely unchanged, and their overall efficiency and productivity was better in some cases while worse in others. In addition, 90% of residents surveyed felt they gained unique skills and experience due to UTDOP's COVID-19 response, and 20% felt their overall experience as a resident was negatively affected due to the COVID-19 pandemic.

Summary

The COVID-19 pandemic created challenges in ensuring ongoing quality patient care, protecting staff and patients, and continuing to provide education during an unprecedented time. This article has described planning and mitigation efforts at The University of Tennessee Medical Center Department of Pharmacy. It is hoped that some of the strategies described, including the integrated practice model, may be useful if subsequent waves of COVID-19 occur or to facilitate other departments' emergency planning efforts.

Disclosures

Dr. Mason is a member of the Academic Innovators Committee of Premier Inc. and president of the Tennessee Society of Health-System Pharmacists. Dr. Flatt is a member of

the National Pharmacy Committee of Premier Inc. and chair of The Pharmacy Committee of Capstone. The other authors have declared no potential conflicts of interest.

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