Insights on developing a field hospital formulary and medication distribution process in preparation for a second surge of COVID-19 cases

**Purpose.** The coronavirus disease 2019 (COVID-19) pandemic has caused health systems across the country to plan for field hospitals to care for patients outside of traditional healthcare settings in the event of a second surge. Here we describe key considerations for the implementation of pharmacy operations and a field hospital formulary at an offsite location within a 2-week time frame.

**Summary.** Development of an offsite field hospital formulary is first dependent on the location and patient population defined for the field hospital. Creation of a limited formulary for a planned field hospital in Michigan involved reviewing physical space limitations and drug distribution workflows, assessing current prescribing trends, creating drug categories, and creating formulary guidelines to limit formulary options in each therapeutic category. Ultimately, our institution developed a 140-medication field hospital formulary, a process to enable appropriate use of nonformulary drugs, and a mixed operations model including automated dispensing cabinets and a manual cart-fill process. Although the institution did not have to open the field hospital, the process used for developing the formulary and determining distribution models will allow for an immediate implementation if a second surge occurs.

**Conclusion.** A methodical approach to developing limited formularies and pharmacy operations in a field hospital setting will allow health systems to establish efficient and effective medication distribution services in the event of a second surge of COVID-19 cases.

**Keywords:** alternative care center, coronavirus, drug distribution, field hospital, formulary, pharmacy operations

The ongoing coronavirus disease 2019 (COVID-19) pandemic, which began in China in December 2019 and in a few short months spread across the globe, had resulted in an estimated 4.5 million infections with the COVID-19 virus and approximately 315,000 deaths worldwide by the end of April 2020. In the United States, COVID-19 infections have been confirmed in all 50 states, and significant outbreaks in New York City and other major cities have strained health systems to the breaking point. In March 2020, President Trump declared the COVID-19 pandemic a national emergency, allowing state governors to request federal assistance and to access supplies from the Strategic National Stockpile. In response, the federal government authorized the Army Corps of Engineers (ACOE) and the Federal Emergency Management Agency (FEMA) to set up makeshift field hospitals in an effort to aid overwhelmed hospitals in cities heavily affected by the outbreak.

Michigan, with an estimated 51,000 cases since mid-March, is among the states most heavily affected by COVID-19. Southeastern Michigan, comprising the city of Detroit and surrounding counties, is the epicenter of the state’s outbreak, with approximately 75% of confirmed cases occurring in Wayne, Macomb, and Oakland counties. As the COVID-19 outbreak surged and...
health systems in the Detroit metropolitan area reached capacity, many patients were transferred to health systems in surrounding regions to receive treatment. Michigan Medicine, a 1,000-bed multihospital academic medical center located in Ann Arbor, MI, was one of the primary destinations for patients testing positive for the COVID-19 virus (“COVID-positive patients”) who were transferred from the metro Detroit area. Predictive models of the COVID-19 outbreak in southeastern Michigan suggested that the transfer of patients to surrounding health systems might be insufficient to meet demand for medical care as numbers of COVID-positive patients continued to rise. To successfully manage an imminent surge, additional capacity would be required. To meet this anticipated demand for healthcare services, Michigan Medicine began developing a 5-phase plan for optimizing care of COVID-positive patients. Phases 1 through 3 focused on optimizing infrastructure and resources on the main medical campus, while phases 4 and 5 were dedicated to creating an offsite medical facility with an additional 500 to 1,000 beds as well as an extended-care facility to fill anticipated gaps in patient care capacity. In late March, internal modeling predicted a doubling of COVID-positive cases every 3 days, which would result in over 5,000 patients requiring care in our health system over the course of the pandemic. Our model estimated that medical campus capacity would be exceeded on April 9, prompting the hospital leadership to greenlight phase 4 on March 26. Initial plans for a 500-bed field hospital were pursued in collaboration with ACOE and FEMA, supplementing similar efforts underway at the TCF Center, an open convention center, in downtown Detroit. The original goal was to be able to open a fully operational field hospital within a 2-week time frame. Work on the field hospital had begun with an assessment of applicable sites prior to FEMA’s engagement. In April, social distancing measures and emergency actions by state and local governments appeared to have helped slow down the spread of COVID-19. As a result of these encouraging trends, the Michigan Medicine leadership decided not to move forward with the field hospital initiative. Nevertheless, public health officials are concerned that a second wave of COVID-19 cases may be inevitable. If a second wave manifests, creation of additional field hospitals may be required to adequately meet demand for healthcare services. Given our recent experience planning for offsite operations in a field hospital environment, this article aims to summarize some key considerations for implementation of pharmacy operations at an offsite patient care facility, with particular emphasis on developing a field hospital medication formulary. Our process is similar to those implemented by hospitals in China during efforts to contain the outbreak. In the event of a second surge in COVID-19 cases, our hope is that these observations will serve as a resource to hospital leaders across the United States as they consider whether to provide patient care at an alternative site and, if so, how to effectively establish pharmacy operations and a limited formulary in a field hospital environment.

Field hospital pharmacy operations overview

Approximately 15 years ago, concern for pandemic spread of influenza prompted the Michigan Department of Community Health to partition the state into 8 medical networks to help plan and coordinate responses to public health disasters. As part of these efforts, health systems were required to develop plans for “alternative care centers” (ACCs) designed to expand the capacity of health systems to care for patients following mass casualty events such as natural disasters, acts of terrorism, and pandemics. At Michigan Medicine, discussions about what these ACCs would look like resulted in an expectation that any offsite patient care facility would provide limited supportive care for non–critically ill patients, while those requiring higher levels of medical care would be treated and closely monitored at the main hospital. As the COVID-19 pandemic progressed and the potential need for a field hospital became apparent, this guiding principle was reaffirmed by the hospital leadership as discussions concerning the operationalization of a field hospital got underway.

Although Michigan Medicine is a large academic medical center, most of the work related to planning field hospital pharmacy operations and a limited formulary was performed by a team of 4 individuals. The team was made up of pharmacists with extensive experience in pharmacy operations, medication use policy, and pharmacy technology whose primary job responsibilities were deprioritized during phases 1 through 3 of our institutional plan for COVID-19 response. For example, elective surgeries were put on hold during initial planning for the COVID-19 crisis; therefore, the assistant director of operating room pharmacies

**KEY POINTS**

- The novel coronavirus pandemic has challenged health systems to develop plans for off-site field hospitals, including drug distribution models and limited formularies.
- This report describes several key elements for developing a field hospital formulary and determining drug distribution models.
- Identifying the field hospital patient population and location, assessing current medication orders, evaluating physical space and workflow constraints, and creating formulary guidelines will help institutions implement field hospital pharmacy services.
was asked to help plan the field hospital. Given the need for development of a formulary, the manager of medication use policy was similarly asked to help, as were a veteran clinical pharmacist with prior experience planning for disaster situations and a pharmacy resident. Given that certain patient care responsibilities (elective surgeries, outpatient pharmacy services, etc.) would be put on hold in a pandemic situation, reallocating personnel in a similar manner is a viable strategy that hospitals could utilize during an “all hands on deck” situation such as a second surge of COVID-19 cases.

Once a team was assembled, the first task was to identify the necessary factors required to establish pharmacy operations at an offsite location. As a starting point, our group considered the following factors:

- The scope of clinical services the pharmacy department would offer
- The numbers and types of pharmacy staff needed onsite to successfully dispense medication to patients
- Whether staff would be redeployed from the main hospital or hired specifically to work in the field hospital
- Whether or not an electronic health record or order entry system would be utilized onsite (and if so, which one)
- How to balance workflow relating to pharmacist patient profile review and order verification with dispensing responsibilities

While important, the above considerations are largely beyond the scope of this publication, which aims to focus primarily on development of a limited field hospital formulary and medication distribution workflow system. Nevertheless, the process outlined may prove helpful when applied to some of the out-of-scope operational factors previously mentioned.

As a first step, it was necessary for our group to define the patient population that would, after a triage period at the main hospital, be moved to the field hospital for further management. By late March, the Michigan Medicine health system had approximately 100 COVID-positive inpatients. A careful analysis of these patients determined that there were 2 main categories of COVID-positive patients: (1) those who required critical care management or mechanical ventilation in an intensive care unit (ICU) and (2) those who were COVID-positive but otherwise clinically stable after a 48-hour initial observation period, defined as remaining afebrile for 24 hours and receiving less than 4 L of supplemental oxygen. In the clinically stable COVID-positive patient group, we also identified patients who were well enough to be discharged but who could not self-quarantine due to social factors, including patients with immunocompromised and/or high-risk family members at home or who lacked housing. Given the anticipated need for conversion of non-ICU patient care units to ICUs in the main hospital, the goal was to transfer clinically stable COVID-positive patients to a field hospital; this would free up non-ICU space in the main hospital for COVID-positive patients requiring ICU-level care. Removing clinically stable COVID-positive patients from the main hospital would also provide an opportunity to isolate them from COVID-negative inpatients, preventing in-hospital virus spread.

Once the field hospital patient population had been identified, the next step was to determine what medications were required onsite to manage the patients so that an appropriate limited formulary could be developed. It is important to keep in mind that our formulary is intended for use in the care of clinically stable COVID-positive patients; if patients requiring a higher level of care were treated in a field hospital, significant revisions to our formulary would be required. Regardless of the acuity of patients to be treated, creation of a limited formulary for the field hospital was essential for a number of important reasons. Physical space for pharmacy operations, storage, and drug distribution was limited at the target facility—an intramural indoor track and field building, with an existing medication room with secured access, that would be rapidly converted into a 500–open bed ACC. Additionally, the need to directly source drugs for the field hospital and an anticipated limited staffing model made creation of a simplified “menu” of drugs appealing to streamline clinical care from both provider and pharmacy perspectives.

**Key elements for developing a field hospital formulary**

To help accurately predict which medications would be needed on the limited formulary, a careful assessment of clinically stable COVID-positive inpatients currently admitted to the main hospital was performed to create a baseline predictive model. After compiling a list of medication orders for patients currently admitted to general care units and conducting a review of those patients’ medication histories, we used our pharmacy-generated model to project onsite drug inventory that would be required in the planned 500-bed field hospital, with quantities scaled up from current inpatient usage levels. Of all of the steps in the formulary development process, assessment of clinically stable COVID-positive inpatients was the critical step for developing the field hospital formulary. It provided an accurate snapshot of what taking care of clinically stable COVID-positive patients in a field hospital setting would entail and enabled us to generate a list of drugs that our provider partners would recognize and agree upon. This work also helped build credibility with the specific providers and administrators working most directly on the field hospital initiative, which we were able to leverage later on when operations-related challenges requiring hospital resources were identified and communicated to the leadership.

Once we had the list of potential formulary medications, we also performed several noncritical but helpful assessments to help refine our proposed formulary. First, we leveraged both national and local clinical
expertise to narrow our scope. On the national level, we sought out suggested formularies from state disaster preparation initiatives and FEMA and, additionally, surveyed medications held in the Strategic National Stockpile to assess whether assistance from state and/or federal agencies would be required. On the local level, we reached out to providers with prior experiences in military-style field hospitals for their advice and analyzed our medication usage trends to identify drugs for which scaled-up acquisition would be required if the field hospital was operationalized. Finally, we surveyed the literature for emerging clinical therapies for COVID-19 to ensure potential treatment options would be available onsite at the field hospital. The process for developing and reviewing a field hospital formulary is summarized in Figure 1.

Based on this work, a list of approximately 140 formulary medications was generated, with subsequent approval by providers and the hospital leadership. Formulary drugs fell into the following categories:

- Comfort medications (ie, those used for pain and fever, nausea and vomiting, diarrhea, and constipation)
- Sleep aids and medications for anxiety and delirium (both short- and long-acting agents)
- Drugs for venous thromboembolism prophylaxis and treatment
- Antidotes and rescue medications (eg, naloxone, flumazenil, glucose gel, epinephrine auto-injectors)
- “Step-down” antibiotics (nonintravenous-infusion antibiotics that could be used to complete therapy for common infections, such as ceftriaxone and oral doxycycline)
- Medications to treat common disease states (eg, hypertension, diabetes mellitus)
- Topical preparations for prevention of bed ulcers
- Emergency medications for patients with cardiac decompensation, including drugs used in rapid sequence intubation

As these drug categories are relatively broad, and given the strong desire by both pharmacy and providers to limit therapeutic options due to space

**Figure 1.** Process for development of a field hospital formulary used by Michigan Medicine pharmacy department. FEMA indicates Federal Emergency Management Agency; MD, physician; RN, registered nurse; PharmD, pharmacist.
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and/or workload concerns, formulary options were restricted using the following guidelines:

- Maintenance medications: limited to 1 or 2 medications from the same therapeutic class
- Herbal supplements/vitamins: excluded from formulary unless needed for management of alcoholism
- Medication dose sizes: only one dose size per drug to be stocked (patient-specific doses can be generated using multiple units)

- Oral liquid alternatives: included on formulary as alternatives to common medications that cannot be crushed or that may be needed in patients unable to swallow capsules or tablets
- Injectables: prioritization of agents that can be administered via intravenous push, intramuscular, or subcutaneous routes to minimize need for infusion devices. (Of note, several intravenous infusion medications [e.g., vasopressors, intravenous cefepime] were allowed on formulary; however, the expectation was that these medications would only be used onsite for short-term stabilization of clinically deteriorating patients prior to their transfer back to the main hospital for more advanced care.)

The above guidelines were helpful to our group in ensuring that appropriate, but not overly redundant, medication options were available onsite. A more detailed list of formulary medication categories, as well as examples of included medications, appears in Table 1.

An additional challenge that must be assessed in reviewing medications for field hospital formulary inclusion

| Medication Category | Formulary Medication Examples |
|---------------------|------------------------------|
| Pain/fever          | Acetaminophen, 325-mg tablet | Ibuprofen, 200-mg tablet |
|                     | Morphine injection (2 mg/mL) | Hydromorphone injection (1 mg/mL) |
|                     | Morphine oral concentrate (20 mg/mL) | Ketorolac injection (30 mg/mL) |
| Nausea/vomiting/diarrhea/constipation | Ondansetron, 4-mg disintegrating tablet | Famotidine, 20-mg tablet |
|                     | Ondansetron injection (4 mg/2 mL) | Famotidine injection (20 mg/2 mL) |
|                     | Prochlorperazine, 10-mg tablet | Bisacodyl, 10-mg suppository |
|                     | Omeprazole, 20-mg capsule | Loperamide, 2-mg tablet |
| Sleep/anxiety/delirium | Lorazepam, 1-mg tablet | Melatonin, 3-mg tablet |
|                     | Lorazepam injection (2 mg/mL) | Lithium oral solution (8 mEq/5 mL) |
|                     | Haloperidol, 0.5-mg tablet | Olanzapine, 5-mg tablet |
|                     | Haloperidol lactate injection (5 mg/mL) | Risperidone, 1-mg disintegrating tablet |
| DVT/PE prophylaxis and treatment | Enoxaparin syringe (all strengths) | Apixaban, 5-mg tablet |
|                     | Heparin injection (5,000 units/mL) | |
| Antidotes/rescue medications | Naloxone injection (0.4 mg/mL) | Flumazenil injection (0.5 mg/0.5 mL) |
|                     | Glucose, 40% oral gel | Epinephrine injection (0.3 mg/0.3 mL) auto-injector |
| Step-down antibiotics | Azithromycin, 250-mg tablet | Ceftriaxone, 1-g vial (for IM use) |
|                     | Levofloxacin, 750-mg tablet | Metronidazole, 500-mg tablet |
|                     | Amoxicillin/clavulanate oral suspension (600 mg and 42.9 mg/5 mL) | Fluconazole, 200-mg tablet |
| Topical preparations | Nystatin/triamcinolone/magnesium hydroxide rash cream | Hydrocortisone, 1% cream |
| Emergency medications | Etomidate injection (2 mg/mL) | Ketamine injection (100 mg/5mL) |
|                     | Rocuronium injection (10 mg/mL) | Succinylcholine injection (20 mg/mL) |
|                     | Norepinephrine infusion (16 mg/250 mL) | Dopamine infusion (800 mg/250 mL) |
| Corticosteroids | Prednisone, 10-mg and 20-mg tablets | Methylprednisolone injection (40 mg and 125 mg) |
| Common disease state | Metoprolol, 25-mg tablet | Potassium chloride, 20-mEq oral packet |
|                     | Lisinopril, 10-mg tablet | Glipizide, 5-mg tablet |
|                     | Losartan, 25-mg tablet | Metformin, 500-mg tablet |
|                     | Hydralazine, 25-mg tablet | Insulin (regular, lispro, and glargine) |

Abbreviation: DVT, deep vein thrombosis; IM, intramuscular; PE, pulmonary embolism.

*List is not inclusive of all medication categories and medications.
relates to drug shortages. Given potential disruptions in manufacturing and allocation, alternative agents may need to be substituted onto the field hospital formulary over the course of a pandemic. Health systems should be respectful and aware of this possibility and proactive in identifying and recommending alternatives for formulary agents at both a main hospital campus and any field hospitals in operation.

Finally, while a limited formulary helps streamline medication use in a field hospital environment, there will always be clinical situations where a nonformulary agent is required. Given this inevitability, a nonformulary medication approval process should be prospectively created during the field hospital formulary development process. The nonformulary medication approval process developed by our institution for a field hospital is summarized in Figure 2.

**Medication distribution workflow**

While the list of formulary agents can be identified and maintained using the above guidance, additional thought must be directed to the actual medication distribution process onsite at a field hospital. First and foremost, licensure of the field hospital pharmacy should be carefully considered. As planning for a Michigan Medicine field hospital was begun, our planning group reached out to the pharmacy leadership for help addressing this problem; in turn, our chief pharmacy officer reached out to the Michigan Board of Pharmacy and the US Drug Enforcement Administration (DEA) for guidance. In response, on March 25 the governor of Michigan issued executive order 2020–25, which authorized pharmacists to temporarily operate pharmacies in areas not designated on their pharmacy license, provided that they do not prepare sterile drugs beyond low-risk products intended for immediate inpatient administration. In addition, on April 10 DEA authorized a licensing exception that allowed hospitals and/or clinics to use their existing registrations at satellite facilities. As a result of these regulatory changes, pharmacies were not required to attain special licensing for offsite pharmacies during the COVID-19 pandemic in Michigan, although these exceptions will certainly expire prior to a second surge. Given this significant hurdle to establishing offsite pharmacy operations, we recommend that hospitals reach out to their state board of pharmacy and DEA for guidance regarding licensure as early as possible in the planning process.

In the end, our institution elected to use a hybrid approach whereby non-controlled substance scheduled medication orders would be filled via a manual cart-fill system, while controlled substances and as-needed medications would be stocked in ADCs.
This strategy would ensure secure inventory and tracking of controlled substances, flexibility for nursing staff to have quick access to as-needed medications when required, and avoidance of potential "traffic jam" scenarios nursing personnel might encounter at high-volume scheduled medication administration times while serving 500 patient beds. Based on our target census of 500 patients, we planned to deploy 32 medication carts for pharmacy technicians to deliver medications to, as well as 7 ADCs, collectively translating to a medication cart for approximately every 15 to 20 patients and an ADC for every 70 patients.

Although much effort was invested in planning for offsite pharmacy operations, ultimately our institution decided not to open the field hospital, depriving us of the opportunity to see how effective our limited formulary and medication distribution workflow plans actually would have been. Even though we did not get to see our plans in action, we nevertheless feel strongly that the effort invested in planning for offsite pharmacy operations was worthwhile for our institution and that our efforts laid a solid foundation that the hospital can build upon should a second wave of COVID-19 or another, unrelated pandemic come to pass. Given this possibility, we feel strongly that pharmacy departments around the nation should invest time developing plans for offsite patient care proactively and hope that the planning experiences shared in this article are of use to pharmacy departments as they develop and refine their own plans for field hospital formularies and operations.

**Conclusion**

The COVID-19 pandemic has challenged health systems throughout the United States in ways never seen before. Although there are signs the pandemic may be slowing, there is a high likelihood that a second wave of infections will occur, and many public health officials feel that COVID-19 may never go away.\(^{18}\) In areas hard hit by the pandemic, state and federal agencies have helped establish field hospitals to increase local healthcare capacity. Given the possibility of a COVID-19 resurgence, designing a formulary intended for use during a pandemic surge should be part of pharmacy departments’ routine emergency preparedness efforts.

Based on our experience planning a COVID-19 field hospital with a limited formulary, this report is intended to provide a resource to help health-system pharmacy departments design such a formulary and, if necessary, successfully establish efficient and effective medication distribution infrastructure in a field hospital environment. It is critical in situations like these to be nimble enough to make rational decisions inclusive of all team members while at the same time ensuring due diligence.

**Disclosures**

The authors have declared no potential conflicts of interest.

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