

Dynamic pharmacy leadership during the COVID-19 crisis: Optimizing patient care through formulary and drug shortage management

Rebecca Ann Pulk, PharmD, MS, Corporate Pharmacy Services, Yale New Haven Health, New Haven, CT ORCID ID:0000-0003-0949-9699

Molly Leber, PharmD, BCPS, FASHP, Corporate Pharmacy Services, Yale New Haven Health, New Haven, CT ORCID ID: 0000-0002-9848-8977

Lydia Tran, PharmD, BCPS, Department of Pharmacy Services, Yale New Haven Hospital, New Haven, CT ORCID ID: 0000-0002-6315-5435

Mahmoud Ammar, PharmD, BCCCP, BCPS, Department of Pharmacy Services, Yale New Haven Hospital, New Haven, CT ORCID ID: 0000-0002-3401-9960

Nilesh Amin, PharmD, Department of Pharmacy Services, Yale New Haven Hospital, New Haven, CT ORCID ID: 0000-0003-0261-8237

LeeAnn Miller, PharmD, MS, Corporate Pharmacy Services, Yale New Haven Health, New Haven, ORCID ID: 0000-0001-7611-0781

Marina Yazdi, PharmD, BCPS, Corporate Pharmacy Services, Yale New Haven Health, New Haven, CT ORCID ID: 0000-0001-5947-9165

Address correspondence to Dr. Yazdi (marina.yazdi@ynhh.org).

Purpose. The coronavirus disease 2019 (COVID-19) pandemic has created unprecedented challenges for health systems around the world. We describe our approach to adapting the pharmacy leadership structure to address critical medication shortages through innovative data analysis, procurement strategies, and rapid implementation of medication policy.

Summary. Yale New Haven Health deployed a system incident management command structure to effectively respond to the COVID-19 crisis. System pharmacy services adopted a similar framework to enable efficient communication and quick decision-making in key domains, including drug procurement and policy. By refining a model to project health-system medication needs, we were able to anticipate challenges and devise alternative treatment algorithms. By leveraging big data and creating a system knowledge base, we were able to consolidate reporting and coordinate efforts to ensure system success. Various procurement strategies were employed to ensure adequate supply, including frequent communication with our wholesaler, sourcing direct from suppliers, outsourcing of sterile products compounding to registered 503B outsourcing facilities, and acquisition of active pharmaceutical ingredients for compounding of essential medications. Strategic positioning of pharmacists within the health system's incident command response teams and rapid adaption of drug use policy governance

fueled accelerated response and nimble implementation. Communication was streamlined and executed via multiple outlets to reach a broad audience across the health system.

Conclusion. With medication shortages posing a threat to patient care, dynamic pharmacy leadership proved essential to providing patient care at the height of the COVID-19 pandemic. System alignment and the rapid adaption of the existing framework for drug shortage management and medication use policy were crucial to success in crisis response.

Keywords: COVID-19, learning health system, organizational innovation, medication supply and distribution, pharmacy, policy

Yale New Haven Health (YNHH) is a 2,475-bed academic health system with 7 hospitals across 4 delivery networks positioned along the Connecticut shoreline from the New York border into Rhode Island. The YNHH pharmacy enterprise has evolved over the past 10 years with standardization of the electronic medical record (EMR), alignment of the medication formulary, and creation of a corporate leadership structure. Though pharmacy efforts are aligned at the system level, each delivery network maintains operational autonomy to ensure the needs of the local stakeholders and practice setting are met. Each delivery network maintains a pharmacy and therapeutics (P&T) committee, which advises the overarching system formulary integration committee (FIC) that governs formulary and medication use policies across the system.

By the beginning of March 2020, it became clear that the coronavirus disease 2019 (COVID-19) pandemic was poised to have a significant impact on the northeast region. Our system leadership anticipated an unprecedented increase in patient volumes and advised all departments to prepare for a 3- to 4-fold increase in intensive care unit (ICU) census as well as an overall census 50% above usual capacity. To prepare for the increased volume, YNHH discontinued elective surgeries, discharged eligible patients to skilled nursing facilities, consolidated care units to low-impact offsite settings, and created a plan to add an additional 1,360 beds. The transformation of negative pressure oncology units and postanesthesia care units to temporary intensive care space expanded system capacity and our ability to assume care of critically ill patients. Overall, YNHH completed the addition of 887 new beds, bringing the total system capacity up to 3,362 inpatient beds.

YNHH activated its system incident management (SIM) team to respond to the rapidly evolving COVID-19 situation and ensure effective communication in the face of uncertainty. The SIM COVID-19 response was aligned and executed through multidisciplinary action teams representing clinical, operational, and logistic sectors across the system. Pharmacy representatives were assigned to each action team to serve as the medication experts and liaisons, allowing for rapid identification and resolution of medication issues, as well as heightened departmental awareness and communication. The diverse perspectives captured through this flexible approach ensured key stakeholder engagement and accelerated consensus and solution generation.

A pharmacy incident command structure (ICS) that mirrored and aligned with the SIM structure was implemented to further parallel our goals of delivering high-quality pharmacy services while maintaining efficient communication and rapid decision-making (Figure 1). Pharmacy-specific pillars supported by nimble action teams allowed our department to address operational unit challenges including staffing, communication, facilities and equipment, education and training, compounding, and regulatory compliance. Each pillar and action team was assigned a pharmacy lead and an alternate to ensure continued support in the event of illness. This structure aligned pharmacy efforts across the system and expedited issue identification and consensus by facilitating communication between SIM and system pharmacy leadership.

As we prepared for the novel contagion, it became clear that the ability to adapt to emerging information and quickly shift resources would be essential to success. The pharmacy executive leadership team reviewed the literature on COVID-19 response readiness and held

several brainstorming sessions to identify potential threats to our ability to provide quality patient care.¹ It was recognized that the shift from normal operations and anticipated surge in ICU patients would present unique and unprecedented medication demand. Medication supply was recognized as one of the top threats to the system's ability to care for all patients, not just those infected with COVID-19. This challenged our group to reimagine our current processes and rapidly adapt them to meet the pending crisis. By building on the existing system formulary process and drug shortage monitoring and mitigation system already in place, we were able to effectively procure and distribute medications across the entire enterprise. We devised a reporting methodology to help determine our medication supply, usage rates, and needs on a daily basis. This approach allowed for deployment of pharmacy resources to create drug use guidelines and shortage mitigation strategies to prevent disruption of patient care. Below we describe 4 strategies employed throughout the first wave of the COVID-19 crisis to manage critical medication supply while providing consistent drug use policies across the system.

Strategies for managing medication supply during a crisis

Projecting patient volume and medication needs. When tackling drug shortages, we typically base our calculation of medication needs on historical monthly usage. We quickly realized that our historical purchase data would not accurately project needs during a COVID-19 surge and a different projection mechanism would be required. Our pharmacy team utilized internal and external epidemiological models in order to project the impact of COVID-19 on our state and estimate YNHH inpatient volume at peak. Initially, the published University of Washington Institute for Health Metrics and Evaluation model projections were scaled to the

system using a set proportion generated by comparing the weekly Centers for Disease Control and Prevention COVID-19 updates for our state.²⁻⁵ As YNHH adopted an internal model, peak projections from this work were used to determine medication needs (Figure 2).

Medication classes essential to the treatment of infected patients were identified through discussion with key stakeholders and the intensive care unit (ICU) medical leadership and review of historical medical ICU order data. To prepare for significant drug shortages, we identified both formulary and nonformulary drug therapies within each essential medication class and communicated with our purchasing team to begin acquiring these medications. Based on the early internal projection of quadrupled ICU patient volumes, our purchasing team secured a baseline supply equal to 1 month of historical use of all essential agents to ensure a 1-week operational capacity ahead of the COVID-19 caseload peak. As YNHH started treating patients with COVID-19, a systematic revision of the COVID-19 essential medication list was performed to capture internal knowledge and emerging recommendations from consensus guidelines and critical care and infectious diseases societies. This transmutation included removal of all antibiotic and antiviral therapies and addition of anticoagulants and adjunctive treatments for ventilated patients.

Medication supply needs were projected by defining the patient populations expected to be treated with each agent, estimating per-patient-per-day therapeutic need for each essential medication, and scaling to epidemiological model patient volumes. We classified essential medications by their anticipated use in 3 defined COVID-19 populations of interest: all hospitalized patients, ICU patients, and ICU patients requiring mechanical ventilation.

Forecasted dosing requirements for anticoagulants and intravenous medications evolved with

the YNHH COVID-19 experience. Initial projections relied on a projected 100-kg dosing weight, a continuous-infusion medication administration rate of two-thirds of the system-defined maximum, and a 10-day length of stay. As our COVID-19 patient volume increased, extraction of YNHH population-level data allowed us to refine our projections to present a true picture of patient volumes and drug utilization patterns. Our daily medication supply needs, expressed in terms of observed vs historical usage, are described in Table 1. Overall, we noticed increased utilization of all essential medication classes except for bronchodilators. Static albuterol inhaler usage patterns were attributed to a shift away from automatic dispensing of inhalers to all patients with albuterol orders, leading to waste reduction. Hydroxychloroquine and tocilizumab had dramatic increases in utilization reflective of their unique role in the treatment of COVID-19. Enoxaparin, ketamine, norepinephrine, and paralytic agent usage rates increased by 7- to 8-fold, while utilization of oral acetaminophen, opioid analgesics, and sedatives quadrupled. There was a 2- to 3-fold increase in utilization of medications used in supportive care of critically ill and mechanically ventilated patients.

Leveraging data and creating a system knowledge base. The lack of published accounts of health-system responses to the COVID-19 pandemic emphasized the need to systematically capture internally generated data. A pharmacy-led reimagining of existing procurement, automated dispensing cabinet, and EMR reports aligned real-time inventory and clinical data sources, positioning the department to adapt to the evolving crisis and make data-driven decisions.

A 2-week investment in the creation of centralized inventory reporting allowed us to understand all available resources and support system hospitals in meeting their needs.

Centralized procurement and transfer of controlled and noncontrolled substances was allowed in Connecticut upon declaration of an emergency by the governor. For sterile compounding garb and supplies, a coordinated daily manual count captured inventory across all sites. For medication inventory, a system-based report was developed in collaboration with our external vendor to allow for a complete daily inventory of all automated dispensing cabinets, carousels, and controlled substance safes. The overall report of essential medication usage rates allowed for identification of quick-moving products and central coordination of medication distribution to sites where need was outpacing inventory. Development of common processes for recording received and stored products ensured all resources were accounted for and available to meet patient need.

The daily medication inventory report was filtered to focus on the COVID-19 essential medication list and allowed for the rapid communication of supply on hand and prioritization of clinical drug use policy and alternative treatment algorithm development. A daily drug shortage report was distributed to all system pharmacists for use in discussions with medical teams.

Other data sources supplemented the daily inventory reports to provide additional insight. Order invoices and received reports enabled inclusion of nonformulary products, which are typically not stored in the automated dispensing cabinets, and tracking of inventory on order. Extraction of order and administration information from the EMR enabled quantification of average medication doses and the number of patients treated throughout the system.

Aligning procurement strategies with treatment recommendations. The YNHH system formulary governance structure has been in place for almost a decade. We leveraged our existing FIC subcommittee framework to rapidly convene a multidisciplinary COVID-19

treatment team, which served as an internal panel of experts and focused on the creation of evidence-driven practice guidelines. This team continually reviewed emerging evidence and disseminated a system-wide COVID-19 treatment algorithm to guide care of adult and pediatric patients. At peak, the treatment algorithm supported use of both hydroxychloroquine and tocilizumab in patients meeting specific criteria. As additional data became available, hydroxychloroquine was removed from the treatment algorithm and remdesivir was added as emergency use supply permitted.

Our established drug shortage identification and mitigation processes were augmented with information gleaned from system-wide inventory reports and modeling work to project usage of critical medications. These processes allowed us to triage system needs and focus procurement efforts on the key medications, including opioid analgesics, paralytics, sedatives, vasopressors, and albuterol inhalers. To ensure support for this critical need, pharmacy staff was reallocated from less essential functions to support existing procurement processes.

Varied medication procurement strategies were employed to ensure adequate supply across the system. Early communication with our drug wholesaler ensured a mutual understanding of our anticipated needs. Shifting to a system perspective allowed for coordinated purchasing efforts, positioning our buyers to coordinate orders and draw from both wholesale distribution centers covering our system geography. Leveraging our relationships with suppliers allowed for the direct acquisition of key medications to supplement our wholesaler allocations. Short-dated and nonformulary options were strategically sourced to bridge system needs, and sources of alternative pharmaceutical ingredients (API) were identified to allow for internal compounding if required to maintain patient care. Government-

managed distributions of hydroxychloroquine and remdesivir provided an additional source of COVID-19 treatment supply.

As a final safeguard, foundational contracting and infrastructure builds necessary to ensure a continued supply of essential medications were explored, particularly for large-volume sterile products. Our ability to shift to sterile products obtained from registered 503B outsourcing facilities was hampered by increased demand. The YNHH sterile and nonsterile compounding committees developed standard operating procedures to allow in-house nonsterile and sterile high-risk compounding with a “hold and release sterility program.” Food and Drug Administration guidance temporarily allowed us to procure API for compounding of fentanyl, hydromorphone, morphine, lorazepam, ketamine, and hydroxychloroquine. Compounding of hydroxychloroquine capsules for inpatient use allowed YNHH outpatient pharmacies to maintain commercial product supplies for patients receiving long-term therapy. Finally, a waiver of the manufacturer registration requirement for hand sanitizer was granted under the executive order of the governor of Connecticut, allowing for bulk compounding of hand sanitizer by the pharmacy department to support system need.

To ensure clinical recommendations aligned with medication availability, pharmacists managing real-time system inventory and medication need modeling joined the drug use policy/formulary incident command team huddle every morning to ensure early identification and communication of supply challenges; this enabled our clinical team to prioritize their tasks and quickly adapt to rapid changes in drug supply.

Clinical pharmacy specialists assigned to the SIM action teams played a vital role in evaluating clinical alternatives and developing drug therapy guidance and innovative mitigation

strategies to ensure sustainable, evidence-based patient care during the COVID-19 surge (Table 2). Rapid development of formulary restrictions, alternative treatment algorithms, and policy changes such as restriction of specific orders to pharmacist entry were prioritized to conserve critical medication supply.

The unique structure and design of the COVID-19 SIM action teams positioned these groups to approve urgent drug use policy changes. Engagement of system key stakeholders in medication-use policy development through this mechanism allowed for rapid approval through an established expedited process established to accelerate review of novel and urgently needed therapies. This pathway was adapted for use during the COVID-19 crisis, with the approval of the SIM executive lead and FIC chair, to allow for rapid implementation of new formulary additions and policy changes. Provisionally approved guidelines and policies were then reviewed at the following P&T committee and FIC meetings to ensure regulatory compliance and determine if any additional changes were required.

After SIM action team approval, the designated clinical pharmacy representatives collaborated with information technology services analysts on new EMR builds and clinical decision support to drive appropriate prescribing. All EMR and smart pump library changes were implemented system-wide, ensuring a standardized treatment approach and allowing for clinical pharmacy staff to cross-cover shifts across the delivery networks. Clinical pharmacy specialists developed educational materials and reference guides for pharmacists, providers, and nursing staff in order to provide education on novel therapies and newly developed policies. Continual monitoring of medication use patterns following policy implementation

allowed our team to assess the effectiveness of deployed measures, provide feedback to frontline clinicians, and adapt messaging and strategies as needed.

Communicating for success. Effective communication to pharmacists, providers, and health-system staff is essential to a successful crisis response. To decrease the risk of exposure, ensure adequate staffing, and align with the state regulations, a large number of pharmacy staff were deployed to work from home, presenting yet another challenge for meaningful and timely communication. With the abundance of information distributed by both the health-system and pharmacy leaderships, early on it became clear that a centralized approach to streamlining communication was needed. The pharmacy communication action team was tasked with ensuring optimal communication of all COVID-19–related information and pharmacy staff engagement. Newly established drug use policies and medication shortage updates were communicated through daily emails to the SIM leadership to ensure dissemination to providers and all health-system staff.

The pharmacy communication action team employed several strategies and modes of communication to ensure outreach to all members of the pharmacy team (Figure 4). An “RxCOVID19” email was sent to all pharmacy staff every evening, providing a summary of clinical, staffing, drug shortage, drug use policy, and operational updates. All communications and resources, including weekly recorded virtual town hall meetings, were compiled on our department website. Evolving drug use policies and clinical recommendations were captured for pharmacy staff in a summary document with updated links to key policies and communications. Medication supply and shortages were communicated through a drug

shortage document that was updated and distributed daily within the pharmacy enterprise and shared throughout the system twice a week.

System pharmacy virtual town hall meetings were conducted 3 times a week via the Zoom videoconferencing app (Zoom Video Communications Inc., San Jose, CA). Our chief pharmacy officer provided general COVID-19 updates and a question and answer session once a week, while the other 2 meetings focused on COVID-19 clinical and drug use policy updates and pharmacist education. Frontline staff were able to raise concerns, provide feedback, and ask questions in real time, with the benefit of these questions and responses being shared with the entire department.

A weekly text message was introduced as a novel mechanism by which to communicate with all pharmacy staff by providing a Web link to a message from our chief pharmacy officer and all relevant updates and communications. An anonymous online platform, called “Caring during COVID,” was developed to capture questions, suggestions, and opportunities for improvement from staff. It also prompted staff members to recognize coworkers who went above and beyond and share strategies for fighting burnout and building resiliency. Curated responses were shared at the system pharmacy meetings and were accessible through the department website.

Discussion

Building on the existing system pharmacy and formulary governance structure and drug shortage monitoring and mitigation process allowed for a successful and timely response to an unprecedented crisis. Coordinated system response and early planning proved essential to

rapid management of drug shortages to prevent care disruption. Pharmacy integration into the SIM team and well-established working relationships within clinical service lines and the health-system leadership accelerated our ability to implement therapy guidelines.

With multiple data inputs in various formats, one encountered barrier was data gathering, consolidation, and interpretation. We learned that a synchronized approach, implemented in collaboration with our data analytics department, was needed to create comprehensive dashboards and projections of future drug supply needs that accounted for current COVID-19 patient volume, reopening of additional services during the recovery phase, and potential future COVID-19 surges. Another challenge was the lack of clinical data and the desire for quick treatment recommendations, which was met by our COVID-19 treatment action team via information dissemination throughout the system via consolidated adult and pediatric treatment algorithms.

Effective and concise communication processes remain essential to pharmacy and health-system staff engagement and awareness of frequent changes. With over 10 iterations of institutional COVID-19 treatment guidelines, daily drug supply updates, and subsequent drug use policy changes, we learned that multiple modes of communication are required to reach all staff. We received overwhelmingly positive feedback from the pharmacy staff regarding biweekly clinical learning sessions and plan to continue those, with a modified cadence, to communicate all P&T committee–specified changes going forward. Our newly established text messaging platform was also very well received, as staff members on all shifts were able to receive information in real time. Finally, sending a daily email with all COVID-related updates decreased email traffic and communication overload during a busy and stressful time for all.

The important lessons learned throughout this process are expected to extend far beyond the current health crisis. Our work to align medication supply data sources has created a framework for system-wide inventory reporting, enabling recovery efforts and empowering data-driven decisions into the future. By engaging medical experts and stakeholders across the system and using established P&T committee governance structures, we were able to accelerate consensus for system-wide policy changes and implement over 20 drug use policies and medication restrictions in a matter of weeks. All policies brought to the P&T committee and FIC for retrospective review were approved with minor or no comments, reinforcing the validity of our established expedited policy approval pathway. Due to an unpredictable drug supply and ever changing COVID-19 case projections, we developed last-resort strategies, such as the albuterol common canister policy and a comprehensive process for high-risk sterile compounding. Although these policies had not been implemented as of the time of writing, approvals were in place to allow quick execution of these strategies should the need arise.

Conclusion

As medication experts, pharmacists are well positioned to ensure system success in the care of all patients during a crisis by promoting safe, efficient, and effective medication use. Having a robust system formulary process in place provided an excellent foundation to enable expedited review of rapidly evolving clinical information, engage key stakeholders, and efficiently implement treatment algorithms based on the latest evidence and supported by an adaptive drug procurement process.

Disclosures

The authors have declared no potential conflicts of interest.

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Key Points

- Aligning internal data sources detailing inventory, usage, and projected patient volumes into a projection model allowed for prioritization of procurement needs and drug shortage mitigation strategies.
- Adaption of existing system processes and streamlined communication with key stakeholders through a system incident management structure allowed for expedited formulary changes and development of alternative treatment algorithms.
- A robust system pharmacy incident command structure allowed for expedited review process for critical drug-related issues as well as system-wide response and communication.

Figure 1. The Yale New Haven Health pharmacy incident command structure is led by the chief pharmacy officer and pharmacy directors as pillar leads. Pharmacy managers, supervisors, coordinators, and clinical pharmacy specialists serve as action team leads.

Figure 2. Projected vs actual patient volumes within the Yale New Haven Health system over time, with data on system patient volume (projected through comparison of results of progressive epidemiological modeling with observed census data), grouped by 3 specific

populations: all admitted patients, intensive care unit (ICU) patients, and ICU patients requiring mechanical ventilation. Though observed patient volumes plateaued below modeled projections, overestimation in the early phase of response helped ensure adequate medication supply for the plateau.

Figure 3. Accelerated drug use policy review process used by Yale New Haven Health. COVID-19 indicates coronavirus disease 2019; EMR, electronic medical record; ICU, intensive care unit; SIM, system incident management.

Figure 4. Communication strategies used by Yale New Haven Health during the response to the coronavirus disease 2019 (COVID-19) case surge. Zoom refers to the Zoom videoconferencing app (Zoom Video Communications Inc., San Jose, CA).

Table 1. Daily Medication Supply Needs at Yale New Haven Health During COVID-19 Crisis^a

Therapeutic Category	Medication	Observed Daily Use at System Case		Fold Increase
		Plateau	FY19 Daily Use	
Analgesics/antipyretics	Acetaminophen ^b	4,800 g	1,240 g	4
Analgesics	Hydromorphone	7.3 g ^c		
	Fentanyl	650 mg ^c	Collectively equivalent to 74 g morphine	4
	Remifentanyl	800 mg ^c		
	Morphine	80 g ^c		
	Ketamine	75 g		
Anticoagulants	Enoxaparin	150 g	21.8 g	7
	Heparin	34 million units	32 million units	Static
COVID-19 therapies	Hydroxychloroquine ^a	2,240 g	10 g	224
	Tocilizumab	32 g	390 mg	82
Electrolytes	Magnesium sulfate	32,000 g	420 g	76
	Potassium chloride	4.1 Eq	2.2 Eq	2
Bronchodilators	Albuterol ^b	45 units	50 units	Static
Paralytics	Rocuronium	58 g	10 g	6
	Cisatracurium	5.8 g	725 mg	8
	Vecuronium	1.9 g	160 mg	12
Sedatives	Propofol	1,250 g	310 g	4
	Dexmedetomidine	350 mg	120 mg	3
	Midazolam	20.5 g	2.2 g	9
	Lorazepam	9.6 g	4.6 g	2
Stress ulcer prophylaxis	Famotidine	5.2 g	2.3 g	2
	Pantoprazole	5.2 g	1.9 g	3
Vasopressors	Norepinephrine	4.6 g	575 mg	8
	Vasopressin	2150 u	700 units	3
	Epinephrine	1 g	415 mg	2
	Phenylephrine	500 mg	275 mg	2
Ventilator care support	Eye ointment	6 tubes	2 tubes	3
	Atropine drops	4 bottles	1 bottle	4

Abbreviations: COVID-19, coronavirus disease 2019; FY19, fiscal year 2019.

^aPharmacy supply efforts focused solely on the availability of sterile, injectable products unless otherwise noted.

^bOral formulation.

^cAmounts of fentanyl, hydromorphone, morphine, and remifentanyl collectively equivalent to 275 g of morphine.

^dMetered dose inhaler.

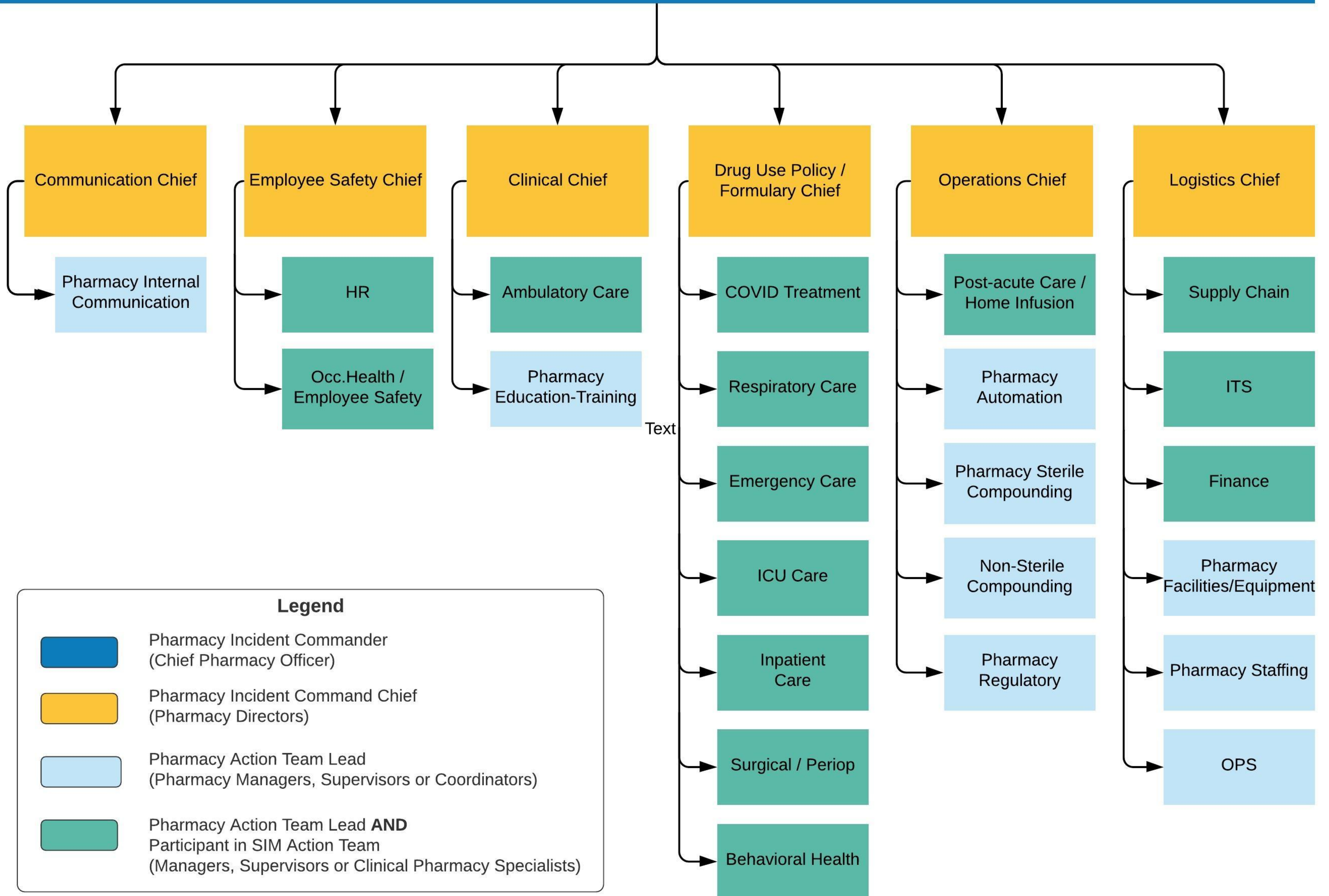
Table 2. COVID-19 Treatment Challenges and Mitigation Strategies Used at Yale New Haven Health

Treatment Area	Challenges	Mitigation Strategies	Implemented Examples
SARS-CoV-2 infection treatment	Rapidly evolving, evidence-based treatment recommendations	<ul style="list-style-type: none"> Weekly literature review by interdisciplinary care team 	<ul style="list-style-type: none"> Treatment algorithm update removing lopinavir/ritonavir, atazanavir, and azithromycin Addition of tocilizumab Addition of remdesivir after emergency use authorization
	Requests for new therapies with limited clinical evidence	<ul style="list-style-type: none"> Restrictions/criteria for use Continuous revisions to system COVID-19 treatment algorithm 	<ul style="list-style-type: none"> Recommendations for use of nitazoxanide, ribavirin, zinc, ascorbic acid, and thiamine
	Management of media recommendations	<ul style="list-style-type: none"> Consistent communication daily 	<ul style="list-style-type: none"> Clinical recommendations for use of NSAIDs and RAAS inhibitors in patients with COVID-19
Supportive care			
Bronchodilators	Risk of nosocomial transmission with nebulized medication therapy	<ul style="list-style-type: none"> MDI with spacer preferred route of administration 	<ul style="list-style-type: none"> Alert in EMR regarding use of nebulized medications in patients with COVID-19 Restriction of nebulized 3% hypertonic saline Epinephrine injection as first-line for symptoms of respiratory distress resulting from hypersensitivity reactions or infusion-related reactions
	MDI shortages	<ul style="list-style-type: none"> Development of common canister policy Implementation of conservation strategies 	<ul style="list-style-type: none"> Changed dispense logic in EMR to minimize redispenses Education for medication history technicians to limit continuation of MDI therapy from home medication list
Analgesics, paralytics, sedatives, and vasopressors	Drug shortages; limited alternatives for patients with organ dysfunction; lack of institutional experience with new therapies; need for frequent monitoring; PPE shortage	<ul style="list-style-type: none"> Identify first line therapies, alternatives, conservation strategies and restrictions Outsourcing from registered 503B outsourcing facilities and compounding from API Sourcing of non-formulary therapies Staff education and clinical decision support in EMR Utilization of alternative therapies with less frequent monitoring 	<ul style="list-style-type: none"> Creation of alternative drug therapy algorithm and clinical decision support within EMR Addition of atracurium to formulary Formulary derestriction of remifentanyl and ketamine Phenobarbital dosing guideline for management of alcohol withdrawal syndrome Guidelines for standing oral opioids, fentanyl patch, and methadone to minimize opioid infusion requirements
Arrhythmia prevention	Increased risk of QTc prolongation with COVID-19 therapies	<ul style="list-style-type: none"> Develop algorithm for monitoring and management of drug-induced malignant arrhythmias 	<ul style="list-style-type: none"> Added laboratory tests and daily ECG to EMR orders
Electrolytes	More aggressive electrolyte repletion and increased demand	<ul style="list-style-type: none"> Develop pharmacist-driven protocol for lab ordering 	<ul style="list-style-type: none"> Pharmacist-driven protocol for ordering of magnesium level determinations

Exposure risk mitigation	PPE shortages	<ul style="list-style-type: none"> • Communication and education • Medication administration, patient assessment and laboratory collection consolidation • Reduce nursing/patient contact • Maximize RTU formulations 	<ul style="list-style-type: none"> • Pharmacist-driven protocol to consolidate medication administration times and blood sampling for laboratory testing • Conversion of i.v. piggyback infusion of thiamine, lacosamide and levetiracetam to i.v. push administration • Use of RTU ampicillin in place of penicillin for GBS prophylaxis • Revised insulin infusion protocol to allow for wider glucose range and less frequent monitoring • COVID-19 alcohol withdrawal syndrome order set with fixed-dose benzodiazepines and phenobarbital
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Abbreviations: API, active pharmaceutical ingredients; COVID-19, coronavirus disease 2019; ECG, electrocardiography; EMR, electronic medical record; GBS, group B streptococci; i.v., intravenous; MDI, metered dose inhaler; NSAID, nonsteroidal anti-inflammatory drug; PPE, personal protective equipment; QTc, heart rate–corrected QT interval; RAAS, renin-angiotensin-aldosterone system; RTU, ready to use; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

Pharmacy Incident Commander

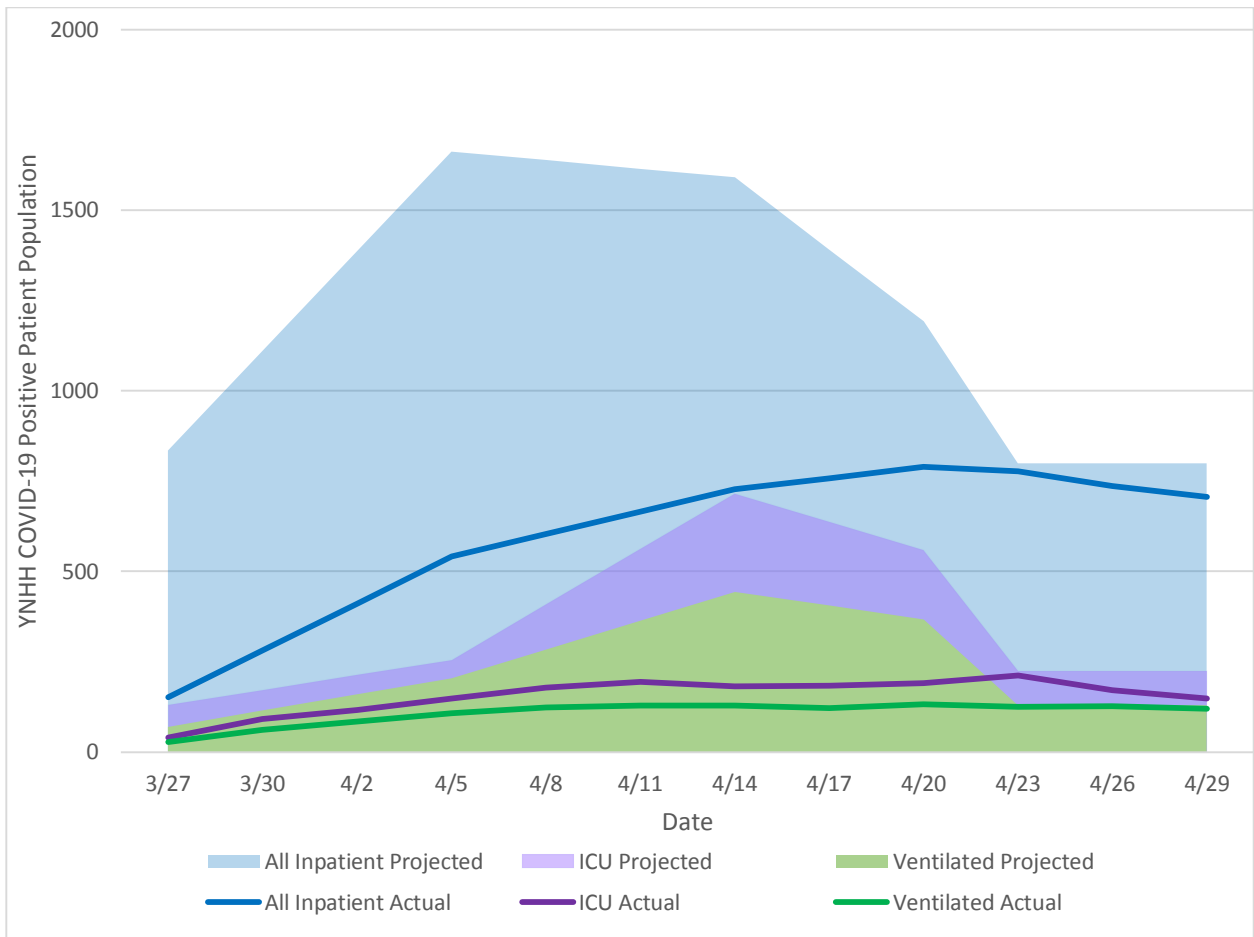


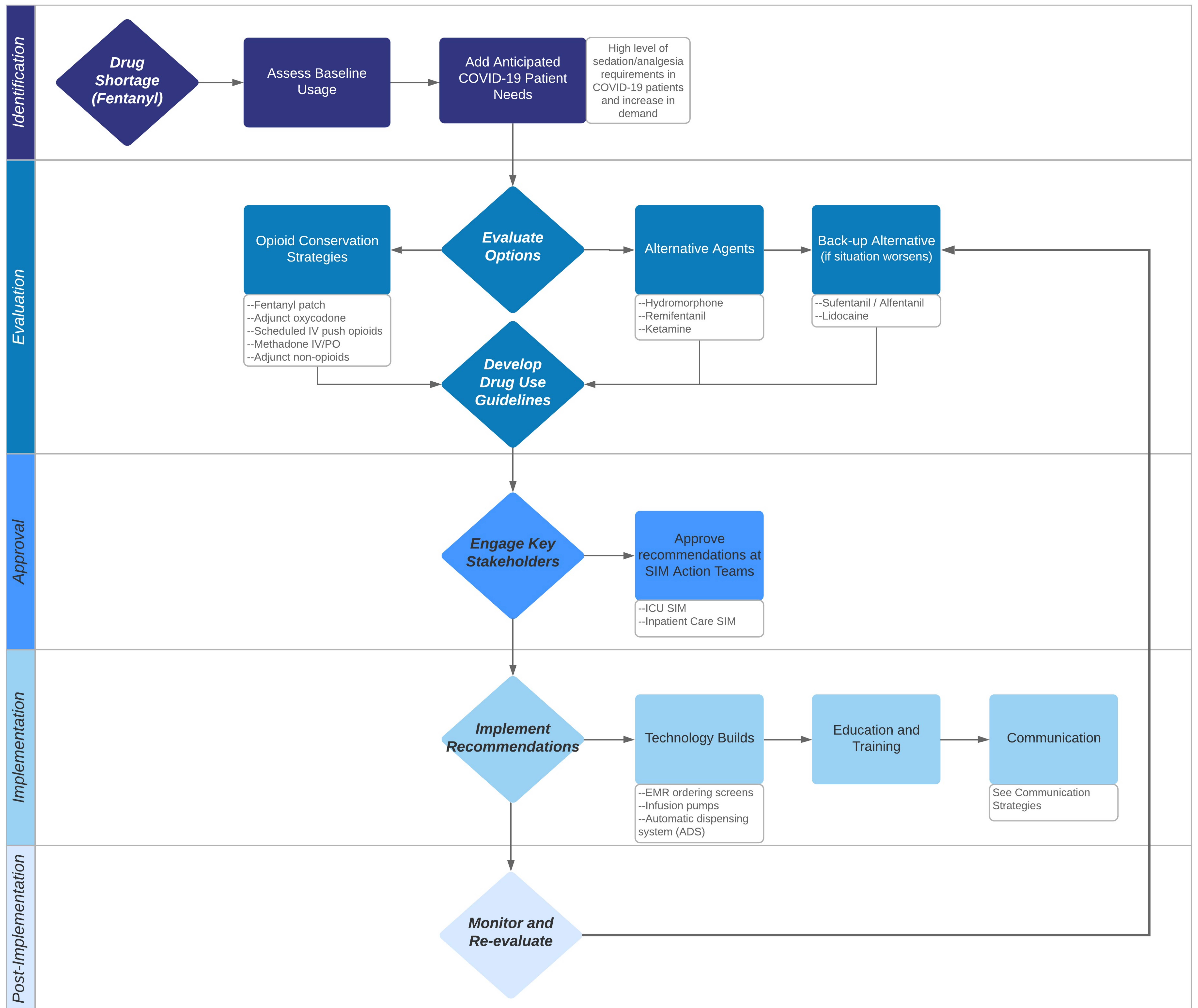
Text

Legend

- Pharmacy Incident Commander (Chief Pharmacy Officer)
- Pharmacy Incident Command Chief (Pharmacy Directors)
- Pharmacy Action Team Lead (Pharmacy Managers, Supervisors or Coordinators)
- Pharmacy Action Team Lead **AND** Participant in SIM Action Team (Managers, Supervisors or Clinical Pharmacy Specialists)

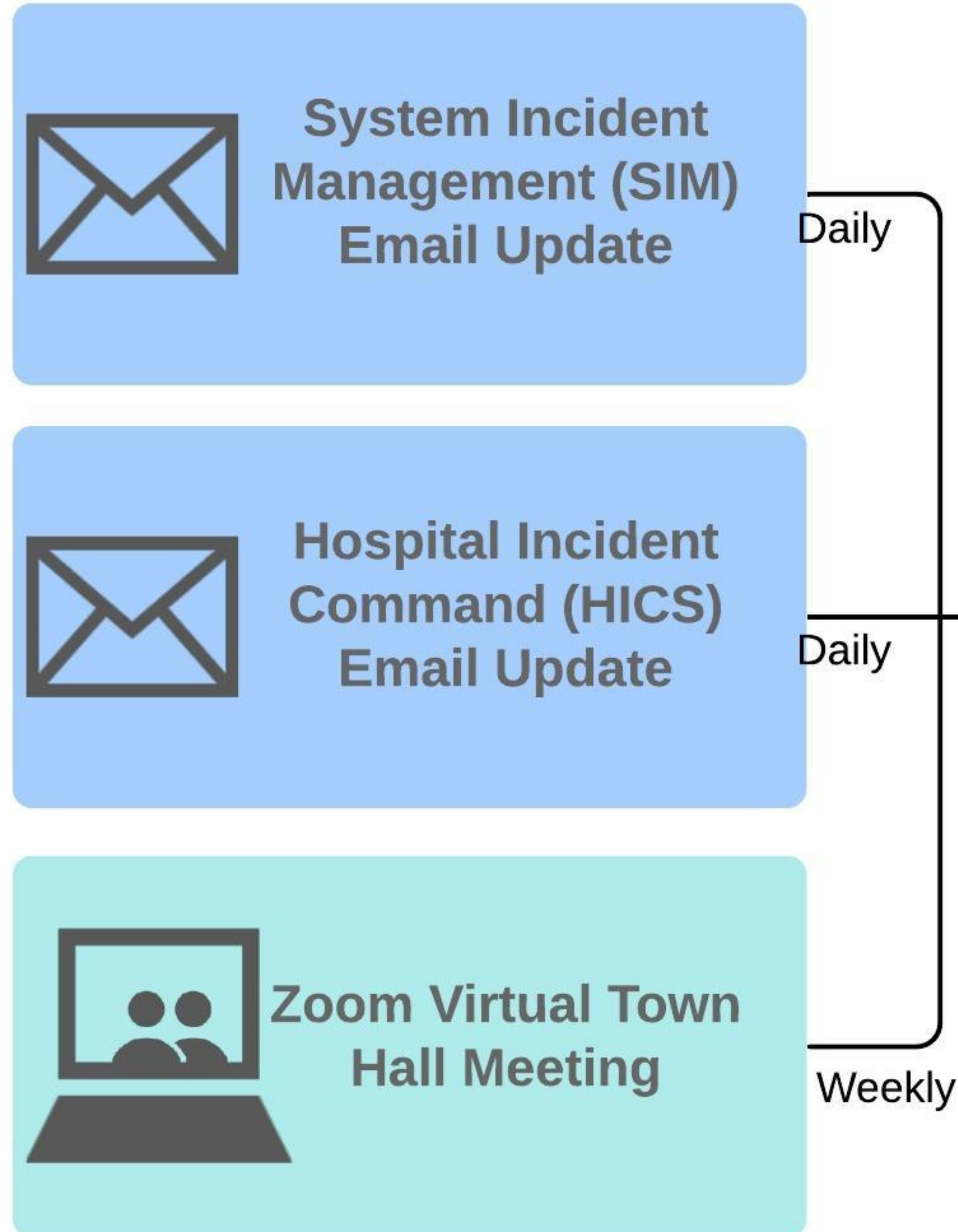
HR: Human Resources; ITS: Information Technology Services; Occ. Health: Occupational Health; Periop: Peri-operative Services; OPS: Outpatient Pharmacy Services





^aExample of opioid response and implementation with the use of the Accelerated Drug Use Policy Review Process

HEALTH SYSTEM System Communication Strategies



All Health System Employees
and Medical Staff

Pharmacy Staff

"Caring during COVID"
Submissions

PHARMACY System Communication Strategies

