Safely caring for adult patients in a pediatric hospital during the COVID-19 pandemic: A focus on the medication-use process

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The novel coronavirus (SARS-CoV-2) outbreak was first reported in Wuhan, China, in December 2019 and rapidly spread throughout the world, resulting in a global pandemic.[1-3] The United States, with its widespread COVID-19 testing and data transparency, leads the world in numbers of confirmed cases and deaths. However, the strain on the healthcare system should be judged not simply by the total number of cases reported but, more realistically, by its impact to the population, reported as number of cases per million. The United States also leads the world in that category, approaching 37,000 cases per million—a death rate higher than reported in other large, developed countries.[4,5] Combined with its significant variability in incidence across the US, its unpredictable severity of illness for individuals, the virus also disproportionately affects adults compared to infants and children.[6] As a result, pediatric hospitals find themselves in a position to offload some patient demand as many adult hospitals scramble to adjust patient census and capacity to care for those sick with coronavirus disease 2019 (COVID-19).

Like any natural disaster, a global pandemic requires swift response and emergency preparedness. As the federal, state, and local governments partnered with local hospitals and major health systems to establish patient triage and support, most pharmacy departments began to estimate staffing, supplies, and medication needs to support COVID-19 with unknown patient demand and limited data available about the virus. As hospitals in known COVID-19 hot spots in the United States exceeded their capacities, strategic efforts became a top priority to accommodate increased patient volumes. Since COVID-19 seemed to be less invasive for infants and children, it became clear that pediatric hospitals could offer some additional capacity.

This commentary offers shared experiences from various pediatric institutions that have implemented or are planning to implement a process to care for adult patients. The goal of this summary is to provide a strategic approach on how pediatric hospitals can ensure safe medication practices for adult patients as well as offering tools to aid in risk assessment and mitigation planning. The recommendations described are most specific to a global pandemic but could be applied to other natural disasters where there is an excess of adult patients overwhelming the healthcare system.

Pediatric Medication Safety Leaders. The Children's Hospital Association (CHA) advances the health of children through innovation in the quality, cost, and delivery of care with pediatric hospitals. With over 220 hospitals, CHA serves as the voice of children's hospitals nationally. A group of CHA Medication Safety Leaders came together and identified inherent risks and a need for pediatric hospitals to have some guidance when asked to admit adult patients during the COVID-19 pandemic to ensure safe medication practices.

Pediatric hospitals located within an adult facility will likely face less challenges accepting adults than a freestanding pediatric hospital. Pediatric institutions are often caring for adult-size patients or adult patients with pediatric disease states, and thus accepting adults as an opportunity to support the local healthcare community in the pandemic is not unreasonable. Resources for caring for adult patients should be carefully considered, as freestanding pediatric hospitals may not have the same access to adult resources as is available in a health system caring for both adult and pediatric patients. Quality indicators important for reimbursement, such as Centers for Medicare and Medicaid Services (CMS) indicators or Healthcare Effectiveness Data and Information Set (HEDIS) measures, should also be considered.

Key stakeholders should be identified to serve as a steering committee to start the preparation and implementation process to ensure optimal care is provided to the adult patients. Institutions with previous experience in hospital expansion could use a similar

approach to implement the new process. At a minimum, directors or representatives of the following teams should be involved: information services, medical staff, nursing, pharmacy, respiratory therapy, quality, radiology, supply chain, patient transport and transfer center, and facilities, including environment of care services and security.

Within the pharmacy department, the leadership team should identify groups of leaders or individuals whose areas will be directly impacted by this new undertaking. The director of pharmacy should engage all of the essential pharmacy services, such as the procurement and inventory management team, clinical pharmacy services team, pharmacy training and development team, and pharmacy medication utilization and medication preparation teams. Clinical operations leaders should evaluate dose preparation, including standard concentrations and common medications used for adult disease states common among patients who may be admitted to the facility. Additional evaluation and considerations should occur around the Institute for Safe Medication Practices (ISMP) best practice standards and floor-stock or automated dispensing cabinet (ADC) recommendations to safely store medications that may not be used in pediatrics but are commonly used in adults.

The pharmacy procurement and inventory team should consider appropriate product selection and balance the safety and financial impact on procurement and storage of adult medications. It is recommended that the clinical pharmacy services team work closely with the medical staff to develop protocols for appropriate dose preparation and adult disease state management if necessary. Additionally, this team should help to assess any staff education needs and develop appropriate training materials. Development of a training manual specific to adult disease state management is recommended; the manual can be shared with pharmacy staff prior to acceptance of adult patients. Mandatory training (with required acknowledgment of understanding by pharmacists)

is strongly encouraged, and leaders should be available to provide timely support for any questions or issues that arise. The pharmacy informatics team also plays an important role in providing technical support to optimize order entry and verification processes to minimize risks of medication errors. It is recommended that a medication safety team be involved to address additional considerations related to ISMP recommendations and the need for any system changes to support adult patient care.

Patient selection. The steering committee should formalize the criteria and process for patient selection, specific location(s) (ie, one or more designated units), and acceptance of adult patients to drive efficient throughput. Children's hospitals have expertise in taking care of pediatric patients with disease states commonly diagnosed in childhood. The first consideration would likely be to maximize space and resources by accepting pediatric patients from surrounding communities to offload cases from some the smaller, more adult-focused hospitals that might be overwhelmed. Most importantly, older adults and elderly patients are the most inappropriate for admittance to pediatric hospitals due to their unique needs and disease states.

A process for required approvals to facilitate a transfer or admit should include oversight by providers, including intensivists and infection control specialists, as deemed appropriate. The steering committee may propose age, weight, and/or other defined restrictions for adult patient admissions, including a confirmed negative COVID-19 test. An example list of patient selection criteria is shown in Box 1. This may serve as an initial list; however, the steering committee will need to adjust rapidly and evaluate criteria on a case-by-case basis at times.

Each organization's steering committee will need to evaluate its preparedness, including the anticipated impact of and resources required to care for adult patients. Figure 1 represents an initial checklist of items to consider in the medication-use process. Although this list is not all-inclusive, it provides a

framework for discussion in each area. Most pediatric hospitals can likely safely care only for young, nonpregnant adults without significant involvement of adult professionals. Furthermore, we recommend that facilities accepting patients outside of these criteria consult adult practitioners during the planning process to ensure all possible gaps and risks are identified. One freestanding pediatric hospital made the decision to admit only patients up to 30 year of age to reduce the potential for acute coronary syndrome or stroke. Facilities accepting older patients at risk for the aforementioned conditions will need to ensure adequate staff competency, cardiac catheterization laboratory capacity, fibrinolytic protocols, and other interventions required.

Staff development. Staff development is an important consideration that key stakeholders need to assess. Any gaps need to be addressed in a timely fashion to equip practitioners who normally care for the pediatric population to be more comfortable and competent. Medical staff need to identify which providers are appropriately trained to care, manage, and treat adult patients. Additionally, clinical pharmacists, nursing personnel, and respiratory therapy teams need to determine any knowledge gaps in adult practice standards and identify who can best develop appropriate training materials. Each institution needs to understand the patient population anticipated and develop training materials based on identified knowledge deficits (eg, recent adult disease state algorithms, guidelines, and consensus statements). To support a safe culture and maintain the highest level of care, a formal escalation process and/or designated subject matter experts should be established for staff to use during times of uncertainty or concern for safety.

Risk assessment. Once you have taken time to identify your key stakeholders, a governance plan, and basic preparedness measures and conduct a review of practice standards, it is important to evaluate the various steps of the medication-use process in

Box 1. Example Of Recommended Adult Patient Selection Criteria For Admission

Confirmed negative COVID-19 test[a]
Not pregnant
Pneumonia/bronchitis
Soft tissue/skin infection
Pyelonephritis
Acute dehydration
Overdose/ingestion (nonsuicidal)
Medically complex patients with diseases presenting in childhood:

- Sickle cell disease
- Cystic fibrosis
- Genetic diseases

Patients recovering from ICU admission for:

- Septic shock
- Acute respiratory distress syndrome
- Diabetic ketoacidosis
- Head trauma/multitrauma
- Postarrest management
- General surgical cases

Identified criteria for adult admission to the PICU:

- Confirmed negative COVID-19 test[a]
- Discretion of the PICU leadership

Abbreviations: COVID-19, coronavirus disease 2019; ICU, intensive care unit; PICU, pediatric intensive care unit.
[a]For pediatric hospitals acting as overflow for COVID-19 patients, a positive test may not be an exclusion criterion.

more detail to minimize adverse drug events (ADEs). To do so, one hospital in Colorado performed a risk assessment to systematically assess risks and design mitigations related to adult care at the institution. This team used the Structured What If Technique (SWIFT)[7]; failure mode and effects analysis (FMEA) or other proactive hazard analysis tools can also be used. It is critical to partner with colleagues with expertise in patient safety, adult and pediatric medicine, emergency response, pharmacy, nursing, and respiratory therapy through a multidisciplinary approach. The medication-related risks will be closely tied to other processes, so a holistic approach including operational and medical considerations is warranted.

Break down your potential risks by each step in the patient care and medication-use process (ordering, verification, dispensing, administration, and monitoring), and other unique scenarios. Suggested risk categories for discussion include admission workflows (eg, admission order sets), decision to admit (eg, medications specific to accepted patients with certain disease states), emergency response, discharge processes, and anticipated clinical scenarios. From a medication-specific perspective, consider ADC and pharmacy inventory and par levels, drug information (related to

new disease states), adult code/emergency doses available on patient care units, and anticipated shortages related to COVID-19. Consider situations where your plan for adult medication-use processes will not work. While many pediatric hospitals already control for adult maximum doses with weight-based dosing, consider current "max dosing" vulnerabilities at your institution and make a plan to close the gap. For example, ask if your current patient-controlled analgesia orders serve all patients, accounting for maximum total dose and, if appropriate, alerts and order entry limits are in place for adult-sized patients.

Risks can be identified in several ways. Process mapping, structured brainstorming sessions, data review, and simulations can all reveal risks and likelihood of risks. Document the likelihood of the identified risk to occur and the impact if the risk did occur. Score the risks according to your chosen risk assessment tool. Prioritize designing and implementing reliable mitigations for the highest-likelihood and most serious impacts first. Document current state mitigations and proposed mitigations, and work through completion of those mitigations prior to accepting adult patients.

Medication-use process. *Prescribing.* When evaluating medication ordering needs for adult patients, the facility should establish the recommended formulary, and considerations for adult dosing and formulations should be evaluated. The informatics team will need to be actively involved and engaged during these discussions to help with decision making and potential adjustment of current logic within the system. Institutions with exposure to adolescents or young adult populations followed by pediatric specialty services may already be prepared for this transition, but others may have more difficulty. Institutions should develop a general consensus on a dosing strategy or approach for when to transition to standard "adult" dosing if one does not already exist.

Figure 1. Example of adult patient preparedness checklist for pediatric hospitals. ACLS indicates advanced cardiac life support; BP, blood pressure; ECMO, extracorporeal membrane oxygenation; ED, emergency department; ET, endotracheal; MI, myocardial infarction; MRI, magnetic resonance imaging; VTE, venous thromboembolism.

Disease State Restrictions
- ❑ Pregnancy, cardiovascular, adult cancers, geriatrics, etc.
- ❑ Unexpected disease states (e.g., acute coronary syndrome, stroke)

Age and Weight Restrictions
- ❑ Age limits (e.g., 30 years and younger)
- ❑ MRI and other imaging weight limits
- ❑ Supplies (e.g., BP cuffs, ET tubes)

Staff Development
- ❑ Disease state education and medication therapy (e.g., VTE, MIs, stroke, etc.)
- ❑ Adult vs pediatric standard process or policy differences
- ❑ Consider simulations to identify risk

Medication Use Process
Prescribing
- ❑ Order set development
- ❑ Clinical Decision Support
    - ❑ Medication file work
    - ❑ Non-weight-based dosing
    - ❑ Drug-drug and drug-disease information
- ❑ Medication reconciliation

Verification and Dispensing
- ❑ Clinical Decision Support
    - ❑ Adult dispensing logic
- ❑ Medication Procurement and Inventory
    - ❑ Par levels
    - ❑ Adult specific inventory not routinely stocked
    - ❑ COVID-19 related inventory
- ❑ Patient home medication use process

Administration
- ❑ Smart Pump Library
    - ❑ Weight based vs non-weight-based libraries
    - ❑ Adult specific library development
- ❑ Standardized adult concentrations
- ❑ Nurse-driven titration order vs provider placed orders
- ❑ Educate to adult vs pediatric medication administration differences
    - ❑ Independent double checks

Emergency Response (Code/Trauma)
- ❑ ACLS and ED code/trauma protocols
- ❑ ECMO considerations
- ❑ Identify code team
- ❑ Adult dosing resources
- ❑ Crash cart inventory

Many institutions use a combination of age and weight parameters to make this transition from pediatric to adult dosing and ideally have those criteria incorporated into the computerized provider order entry (CPOE) system to drive appropriate "adult context" dosing. Many CPOE systems have the ability to use this context, patient age, and weight to guide safe medication ordering, dispensing, and administration. These features can be used to provide appropriate dosing and frequencies, concentrations, formulations, and more. Maximizing the resources of available CPOE technology to guide provider defaults will streamline the ordering process and reduce the risk of prescribing errors.

Lastly, consider prescribing needs for disease states that you may begin to see, including new medications and formulations. One New York City institution created a job aid for a pediatric intensive care unit that was admitting high volumes of adult patients to help educate the healthcare team on important differences in ordering and administering medications. They raised awareness of the agreed-upon adult resources such as the institution's adult anticoagulation

and venous thromboembolism prophylaxis guidelines. They also raised awareness of when CPOE "adult" prompts may not be in line with the pediatric unit's normal ordering practices and how to adjust when required.

Verifying and dispensing. In preparing medications for adult patients on pediatric units, it is imperative to identify a strategy for dispensing and whether it will differ for adult patients. The pharmacy informatics team will need to be actively involved throughout this process. Dispensing patient-specific intravenous (IV) or oral liquid doses is commonly recommended as a safety standard, especially for high-risk medications and high-risk populations such as pediatric patients. Exact-dose dispensing practices are helpful to maintain for adults in a pediatric unit, if feasible, to maximize safety and maintain clear expectations for the received medications. For pediatric hospitals that function within an adult hospital, dispensing practices could be different between locations, but systematically the electronic medical record is shared with logic setup based on each location's established practice or is age specific. For example, if a patient is greater than 18 years of age, dispense a unit dose cup; if less than or equal to 18 years of age, draw up the medication as a patient-specific oral extemporaneous preparation. This can also happen with sterile products; for example, an "adult" location may dispense IV piggybacks with varying concentrations, while the "pediatric" location uses standard concentrations for intermittent infusions. While built-in dispense logic can be good, this can become more complex with mixed populations to accommodate location or age-specific practices. This requires more manual manipulation by the pharmacist during order verification to change dispensing to meet standard expectations that could add additional risk. Separating adult patient medication verification and dispensing responsibilities from that of pediatric patients may reduce risk of error by heightening awareness to the patient populations and the significant differences in the dosing and formulations;

however, challenges in maintaining this standard may arise.

Optimizing and using ADCs to their maximum capacities may also be beneficial to decrease the dispensing and delivery burden, minimize risk of manual patient-specific dispensing errors, and help improve access to needed medications. One lesson shared was keeping clear records of any ADC additions or par modifications to ensure a seamless reversal when a pediatric unit is no longer in need of the adult formulations.

Administration. Smart pump considerations play a large role in the safe administration of IV medications. It is critical to ensure that the smart pump library is updated to accommodate any planned practices changes (eg, modified order sets). This updating may include new concentrations or formulations for use in the new adult patient population. It may be beneficial to use a separate adult library for patients classified as "adult" that will follow adult concentrations, formulations, and standards to minimize the risk of adding new formulations to the existing pediatric library. One hospital in California performed a comparison of its current standardized continuous infusion concentrations and the American Society of Health-System Pharmacists (ASHP) IV adult continuous infusion guidelines to align with adult best practices.[8] It is important to use CPOE and clinical decision support to ensure order sets match smart pump libraries and guide the selection of the appropriate concentration(s).

Cultural practice changes are also important to discuss as a team and decide how best to proceed. One institution reported using nurse-driven titration orders for the administration of sedation medications and vasopressor infusions to adult patients, but for pediatric patients individual provider-placed orders were required. As they started admitting adult patients into their pediatric ICU unit, they made a decision to keep their historic "pediatric practice" of provider-ordered titrations in all patients to maintain consistency in practice for their unit. In contrast, a different pediatric unit was converted completely

to an adult COVID-19 unit, still primarily supported by pediatric healthcare providers. This team felt comfortable converting their standard to adult titration practices and transitioned successfully. This example highlights that different approaches may be justified as each care area and team weighs capabilities of the system, experience of the team, and the needs of patients.

Most importantly, ongoing communication and education regarding expected differences in medication administration for adult patients on pediatric units is critical for patient safety. Each institution should raise awareness, especially for high-risk medications, of any relevant practice changes for adult medication administration. For example, a system may implement independent double check sign-off requirements for adults or different monitoring requirements for particular medications. A lack of system safety tools and prompts may also increase risk for administration errors. Therefore, to maximize safety with medication administration, changes in administration prompts or dispensing standards are important to communicate.

Emergency response (code/trauma). Additional practice considerations include establishing when to use an advanced cardiac life support (ACLS) vs a pediatric advanced life support (PALS) algorithm, determining which teams will respond to emergency events, and deciding if the unit will follow adult guidelines or order sets (if they exist) or pediatric versions. If your facility is a center for extracorporeal membrane oxygenation (ECMO), consider readiness of the pediatric team to accept adult patients requiring ECMO if there is a need and make appropriate adjustments. These are important topics to discuss as a multidisciplinary team and determine the safest method to proceed as well as any system changes or education that will need to be implemented.

Specific to emergency management services, most hospitals currently use cardiac resuscitation carts designed to support both adult and pediatric

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Box 2. Best Practices for Pediatric Hospitals Preparing for Adult Patients

1. Establish a governance and steering committee to make decisions (include, eg, members of hospital leadership, clinical, ancillary, informatics, quality teams)
2. Establish a dedicated unit or area to admit adult patients if feasible.
3. Restrict to younger adults (age of <30 years) if feasible.
4. Restrict to disease states that pediatric providers feel confident treating.
5. Confirm that all staff caring for young adult patients are appropriately trained.
6. Follow standard hospital processes, policy, and formulary.
7. Add to daily huddle or brief for safety or staffing concerns and reassess as needed.

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patients. Par levels and supplies may need to be assessed to make sure essential medications are readily available, especially if a pharmacist does not routinely respond to codes.

Most important is to keep to your standard process for PALS and/or ACLS algorithm for code/trauma response so there is less opportunity for mistakes or insufficient supply. Consider a review of code dosing sheets or other resources and simulation methods to identify inefficiencies, risks, or error-prone steps.

Closing notes. During the first few months of the COVID-19 crisis, the healthcare system was very vulnerable to the negative financial impact of the pandemic. Many institutions were flexing down, furloughing, or laying off frontline healthcare providers initially as elective surgeries were eliminated and capacity was reduced. Then, labor pools and other workforce strategies had to be quickly resourced to accommodate unpredictable surges of COVID-19 cases.

A summary of best practices based on experiences of pediatric hospitals around the country that were faced with a rapid response for admittance of adult patients during the early months of the pandemic is shown in Box 2. The most important lesson learned was to continue practices and processes that are standard to the institution. Large practice and process changes that deviate significantly from the standard are error prone and add risk. Accept adult patients just as if they were any other patient. By taking advantage of the current process, there are less likely to be treatment delays and errors sacrificing patient safety, and a more efficient timeline can be established to minimize the burden to the adult healthcare facilities.

Establishing solid governance for implementation and decision making is essential to success. Decisions to maintain standard practice and limit process changes are important to alleviate an already stressful environment. A strategic evaluation of the medication-use process, including procurement, ordering, dispensing, and administration, is critical to assess risk and medication safety concerns or gaps. Lastly, emergency preparedness planning for proactive response to a global pandemic or viral outbreaks should be implemented. Review standard operating procedures and policies annually, and consider tabletop discussions and drills. Development of a checklist that institutions can use to prepare in a timely fashion is beneficial in preparing for any unanticipated surge in the adult patient census.

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Disclosures

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References

1. Khan S, Siddique R, Shereen MA, et al. The emergence of a novel coronavirus, severe acute respiratory syndrome coronavirus 2: biology and therapeutic options. *J Clin Microbiol*. Published online April 23, 2020. doi:10.1128/JCM.00187-20

2. Centers for Disease Control and Prevention. First travel-related case of 2019 novel coronavirus detected in the United States. Published January 21, 2020. https://www.cdc.gov/media/releases/2020/p0121-novel-coronavirus-travel-case.html

3. Cucinotta D, Vanelli M. WHO declares COVID-19 a pandemic. *Acta Biomed*. 2020;91(1):157-160.

4. Our World in Data. Cumulative confirmed COVID-19 cases per million people [for date]. Accessed November 23, 2020. https://ourworldindata.org/coronavirus-data-explorer?tab=map&country=USA~GBR~CAN~BRA~AUS~IND~ESP~DEU~FRA~RUS~OWID_WRL~CHN&region=World&casesMetric=true&interval=total&perCapita=true&colorScale=continents&smoothing=0&pickerMetric=location&pickerSort=asc

5. Our World in Data. Cumulative confirmed COVID-19 cases per million people. Accessed November 23, 2020. https://ourworldindata.org/coronavirus-data-explorer?country=USA~GBR~CAN~BRA~AUS~IND~ESP~DEU~FRA~RUS~OWID_WRL~CHN&region=World&casesMetric=true&interval=total&perCapita=true&colorScale=continents&smoothing=0&pickerMetric=location&pickerSort=asc

6. Centers for Disease Control and Prevention. United States COVID-19 cases and deaths by state. Accessed November 23, 2020. https://covid.cdc.gov/covid-data-tracker/#cases_casesper100k

7. Card AJ, Ward JR, Clarkson PJ. Beyond FMEA: the structured what-if technique (SWIFT). *J Healthc Risk Manag*. 2012;31(4):23-29. doi:10.1002/jhrm.20101

8. American Society of Health-System Pharmacists. Standardized concentrations: adult continuous IV infusions version 1.01. Standardize 4 Safety. Accessed September 9, 2020. https://www.ashp.org/-/media/assets/pharmacy-practice/s4s/docs/s4s-iv-adult-continuous-infusion-guiding-principles.ashx