


CLINICAL CONCEPTS

Pediatrics

Pediatric capacity crisis: A framework and strategies to prepare for a pediatric surge

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Abstract

A pediatric capacity crisis developed across the country in the Fall and Winter of 2022 due to a combination of factors, including a surge in respiratory viruses, staffing shortages, and historical closures of inpatient pediatric units. The COVID-19 pandemic and associated surge in critically ill adult patients demonstrated that health care systems and health care workers can quickly implement creative and collaborative system-wide solutions to deliver the best care possible during a capacity crisis. Similar solutions are needed to respond to future surges in pediatric volume and to maintain a high standard of care during such a surge. This paper aims to build upon insights from the COVID-19 and H1N1 pandemic responses and the 2022 pediatric capacity crisis. We provide specific recommendations addressing governmental/policy, hospital/health care system, and individual clinician strategies that can be implemented to manage future surges in pediatric patient volume.

KEYWORDS

capacity crisis, health care systems, pediatrics, policy

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1 | INTRODUCTION

In the Fall and Winter 2022, health care systems experienced surges in pediatric volume that threatened their capacity to provide high-quality care. The reasons for this crisis were multifactorial: changes in seasonality and immunity to respiratory syncytial virus (RSV), concurrent outbreaks of COVID-19 and influenza, shortages of pediatric staff,¹ and the decreasing availability and increasing regionalization of pediatric care in the United States. A recent study found a 12% decrease in the number of pediatric beds from 2008 to 2018, with decreases most pronounced in rural areas.² Reasons for these changes may include difficulty retaining pediatric staff and trends whereby more pediatric admissions are covered by Medicaid, potentially reducing revenue and profitability.²⁻⁴

Moreover, the 2022 pediatric capacity crisis coincided with a national crisis of emergency department boarding of adult and pediatric patients. The American College of Emergency Physicians and numerous health care organizations sent a letter to President Biden in November 2022 outlining the urgency of addressing the crisis of ED boarding across our country and emphasizing the plight of boarding pediatric patients requiring inpatient psychiatric care.⁵ In response to the combined challenges of ED boarding and a pediatric surge, some hospitals postponed elective surgeries, cared for pediatric patients on adult hospital floors,⁶ used tents to evaluate pediatric ED patients,⁷ and even implemented crisis standards of care.⁸ The November 2022 American Academy of Pediatrics statement on the care of patients during surges provided guidance for maintaining a high quality of care during surges across ambulatory settings, community hospitals, and tertiary care centers.⁹

Earlier in the COVID-19 pandemic, broad changes were made to respond to a surge of adult patients. These changes included training and deploying pediatric clinicians to care for adults,¹⁰ postponing elective surgeries to preserve resources,¹¹ and developing field hospitals,^{12,13} among other responses. Despite this experience, optimal strategies for addressing a pediatric capacity crisis from a system perspective remain to be described. Therefore, the focus of this work is to provide specific recommendations addressing governmental/policy, hospital/health care system, and individual clinician strategies that can be implemented in response to a pediatric surge.

2 | METHODS

This list of proposed strategies was developed based on a review of relevant literature and prior practices responding to surges in volume. A series of searches were conducted in Ovid MEDLINE (1946 to present) using controlled vocabulary and keywords for pediatrics and alternate care sites. Additionally, citations from Paras et al.'s systematic review article related to alternative care sites were considered.¹⁴ These references informed an initial list of proposed recommendations. The team of coauthors, who have diverse backgrounds and significant experience in pediatric emergency medicine and preparedness (Appendix S1), then held sessions to add to and further refine these proposed

The Bottom Line

Hospitals across the U.S. experienced a pediatric capacity crisis in the Fall and Winter 2022 that threatened their ability to provide high-quality care. Building upon insights from prior pandemics and surges in volume, this article provides specific recommendations addressing governmental/policy, hospital/healthcare system, and individual clinician strategies that can be implemented to address a pediatric surge.

recommendations until we arrived at a consensus. Additional references were subsequently gathered to provide more context on the recommendations developed by this consensus process.

2.1 | Framework

In response to disasters and capacity crises, one framework that has been proposed is the "Four S" model of preparedness, which refers to space, staff, stuff/supplies, and system.¹⁵ Therefore, in Table 1 we outline proposed strategies for responding to a pediatric surge, stratified by level of intervention (ie, governmental/policy, hospital/health care system, and individual clinicians) and by the "Four S's" of preparedness.

2.2 | Governmental/policy strategies

2.2.1 | Space

During surges, new spaces may be needed, and "alternative care sites" such as conference rooms, tents, and after-hours outpatient clinics can be used to care for lower acuity patients.¹⁶ From a policy perspective, lifting governmental restrictions on and expediting approval for use of alternative care sites would facilitate increased hospital capacity.

2.2.2 | Staff

Securing additional staffing is key to managing an increased volume of patients. During the COVID-19 pandemic, United States hospitals expanded credentialing to enable pediatricians to care for adults with COVID-19.¹⁷ In other countries, national exceptions facilitated pediatricians caring for adult patients.¹⁸ Similarly, during times of pediatric capacity crisis, national exceptions could enable clinicians with only adult training to be quickly credentialed to care for children, particularly older adolescents. Accreditation Council for Graduate Medical Education changes could enable trainees to temporarily work outside of required clinical areas. Finally, telemedicine could help address surge needs; policy changes, such as lifting individual state licensure requirements for telemedicine visits, can facilitate this.¹⁹ Although many

TABLE 1 Proposed strategies by “Four S” model and level of intervention.

	Space	Staffing	Supplies	System
Governmental/policy	<p>Lifting of restrictions on use of alternative care sites (eg, conference rooms, outpatient clinics after hours)</p> <p>State/local authorities should communicate process for approving alternative care sites and provide prompt notification when spaces approved for use</p>	<p>National exceptions to enable nurses to be credentialed to care for pediatric patients</p> <p>ACGME changes to permit trainees to work outside required clinical areas for short period of time</p> <p>Lifting of state licensure requirements for telemedicine visits</p>	<p>Government funding opportunities to reimburse supplies related to telemedicine</p> <p>Incentivize and support robust supply chain to preserve supplies of critical pediatric medical devices and pharmacotherapies</p> <p>Modifications to government stockpiles to support pediatric surges</p>	<p>State and national incentives to improve pediatric readiness</p> <p>Development and maintenance of repository of pediatric beds and associated capabilities (eg, PICU beds, ECMO available, burn center) in a given region</p> <p>Designation of a coordinating body to assign beds to those most likely to benefit in that region</p>
Hospital/health care system	<p>Conversion of adult beds and adult ICU beds to serve (preferentially older) pediatric patients</p> <p>Conversion of PACU to PICU beds and/or general pediatric floor beds to PICU beds</p> <p>Use of alternative care sites (eg, conference rooms) for inpatients</p> <p>Expand range of services that can be provided at home (eg, home oxygen) and development of home hospital programs similar to programs available for adults</p> <p>Development of pediatric ED telehealth program</p> <p>Creation of field hospitals or tents to provide care for low acuity patients</p>	<p>Offering moonlighting opportunities for staff credentialed to care for pediatric patients</p> <p>Facilitating expedited recredentialing of recently retired health care workers</p> <p>Credentialing to enable certain adult-trained clinicians to care for children</p> <p>Expedited approval of telemedicine credentialing</p> <p>Development of telehealth consult program to leverage expertise of pediatric intensivists, subspecialists, respiratory therapists, and nurses</p>	<p>Maintenance of hospital stockpiles that include supplies for pediatric patients</p> <p>Collaboration across hospitals to share supplies (eg, high flow nasal cannula oxygen, ventilators, cribs)</p> <p>Use of color-coded supply carts to assist clinicians with less experience caring for children</p>	<p>Development of criteria for PICU admission (vs admission to adult ICU)</p> <p>Optimizing use of pediatric practices such as through financial support for extended office hours and greater use of sick visits</p> <p>Optimizing use of urgent cares (eg, posting wait times)</p> <p>Digital solutions (eg, text messaging program) to help those who leave pediatric ED without being seen access care</p> <p>Consideration of pausing elective procedures</p> <p>Ensuring clinicians who will care for children are PALS certified</p> <p>Dissemination of educational resources including clinical protocols to facilitate clinicians caring for pediatric patients</p>
Individual clinicians	<p>Preventing admissions for conditions that could be evaluated safely with close outpatient follow-up</p> <p>Recognize those who may not need specialized care and could be transferred to alternative site for admission, when available</p>	<p>For clinicians with prior training and expertise in caring for pediatric patients, consider stepping forward for reassignment to help increase available clinical staff</p> <p>For adult-trained clinicians, remain adaptable when assigned to care for older children admitted to adult floors or ICUs</p>	<p>Make efforts to conserve equipment</p> <p>Access training in using pediatric equipment including code carts, airway equipment, pediatric-sized lab tubes, and common medications</p>	<p>Provide feedback to policymakers and hospitals/health systems regarding changes implemented during surge so improvements can be made in the future</p>

Abbreviations: ACGME, Accreditation Council for Graduate Medical Education; ECMO, extracorporeal membrane oxygenation; PACU, postanesthesia care unit; PALS, pediatric advanced life support; PICU, pediatric ICU.

states require physicians to be licensed in the state where the patient is located to provide telemedicine services,^{19,20} early in the COVID-19 pandemic states had emergency orders permitting telehealth from those licensed out of state, and out-of-state telehealth visits increased during this time.²¹ Some states offer telemedicine specific licenses,¹⁹ which could streamline this process.

2.2.3 | Supplies

Given the importance of telehealth in a capacity crisis, governmental agencies could offer funding to facilitate telemedicine expansion. For example, the Federal Communications Commission developed a COVID-19 Telehealth Program enabling health care workers to apply for funding for tablets, telemedicine platforms, remote pulse oximetry monitors, and other telehealth supplies.²² Additionally, it is important for policies and governmental agencies to incentivize and support robust supply chains to preserve supplies of critical pediatric medical devices and pharmacotherapies. This includes ensuring that the Strategic National Stockpile (SNS) and state stockpiles are robust enough to support surges and can release medications as has been done in prior pandemics.²³ Notably, the COVID-19 pandemic precipitated the expansion of the SNS to increase the volume of certain medical supplies (eg, personal protective equipment, ventilators) and add new supplies (eg, nasal swabs for testing, sedative medications), many of which could be valuable in a pediatric respiratory infection surge.²⁴

2.2.4 | System

We recommend state and national incentives and/or mandates to improve pediatric readiness. The National Pediatric Readiness Project (NPRP) checklist for EDs includes recommendations for disaster preparedness and ensuring EDs are prepared for surges in pediatric volume.^{25,26} However, only approximately half of children in the United States lived within 30 minutes of an ED that scored at least at the 90th percentile of pediatric readiness.²⁷ Although readiness scores have not improved significantly between 2013 and 2021,²⁸ state pediatric facility recognition programs that incentivize ED pediatric readiness²⁹ have been associated with EDs having significantly higher pediatric readiness.²⁹ Treatment at a hospital with high pediatric readiness has been associated with decreased mortality.^{30,31} Pediatric readiness is necessary but not sufficient for high-quality pediatric care so, per NPRP guidelines, each ED should have a pediatric physician and nurse champion, who can facilitate dissemination of interventions.²⁵

Another critical step in improving care during surges is to optimize transfers across institutions in a region. Currently, in many regions, a representative from a hospital hoping to transfer a patient must call nearby hospitals directly to inquire about bed availability, repeating this process across a larger geographic region until a bed is secured. This process is time consuming, inefficient, and may lead to suboptimal distribution of resources and transfer delays. We recommend developing a centralized repository of pediatric resources, tabulating

beds and associated capabilities in a given region including: number of available inpatient and pediatric ICU (PICU) beds; critical care capabilities including extracorporeal membrane oxygenation capability; and current ventilator availability. To optimize resource use, a regional coordinating center such as a state's health department or other local governmental agency could assist with assigning beds to the patients most likely to benefit.

There are examples of transfer coordinating centers in several regions that can inform similar initiatives. During the COVID-19 pandemic, Colorado formed a statewide transfer center to serve as a centralized point of contact for hospitals to transfer patients requiring a higher level of care, and for hospitals that are at capacity to transfer patients who no longer require specialized care and could continue their admission elsewhere.³² Similarly, a collaboration across hospitals in Iowa, Kansas, Missouri, and Nebraska was formed in 2022 in response to the pediatric capacity crisis to coordinate pediatric transfers.³³ One children's hospital contacted other hospitals in the region each morning to inquire about available PICU beds, then facilitated transportation between hospitals when required.³³ In Maryland, a "Critical Care Coordination Center" was developed in 2020 in response to the COVID-19 pandemic and was more recently expanded to facilitate transfers of critically ill pediatric patients, including through use of a "real-time" list of inpatient capacity at facilities across the region.³⁴ Although there is a range of ways in which transfer coordinating centers could be developed, ideally regions would have digital dashboards listing hospitals' available capacity in real time, and hospitals could automatically upload these data. Where this is not feasible, an alternative is for the coordinating center to call regional hospitals twice daily to tabulate available beds.

2.3 | Hospital/health care system strategies

2.3.1 | Space

During the early COVID-19 pandemic as there were surges in adult volumes, many hospitals converted PICU beds to adult ICUs.^{18,35,36} However, nationally, only approximately 6% of non-neonatal ICU beds are PICU beds.³⁷ In response to pediatric capacity crises, hospitals could consider converting a portion of available adult ICU or floor beds to serve children. Hospitals could decrease the age threshold for adult ICU admissions, prioritizing patients who are both ≥ 12 years and ≥ 40 kg, because these patients can generally be cared for using adult medication dosing and equipment.³⁵ Similarly, when there is available neonatal ICU capacity, hospitals could raise the age threshold for children to be admitted to the neonatal ICU instead of the PICU, as has been recommended by the Massachusetts Department of Public Health.³⁸

Additionally, pediatric and adult postanesthesia care units (PACUs) could be modified to care for critically ill pediatric patients during a surge, as was done for critically ill adults with COVID-19, particularly if certain elective procedures are postponed and PACUs are therefore less used.³⁹ There is also precedent from prior influenza outbreaks

for the use of alternative care sites (eg, conference rooms) to create additional inpatient beds for lower acuity patients.^{16,40}

Finally, another way to increase inpatient pediatric capacity is to expand the range of services that can be provided at home. For adults, hospital-at-home programs were developed during the COVID-19 pandemic that remotely monitored patients at home, provided oxygen therapy,⁴¹ and employed paramedics for in-home evaluations.⁴² During pediatric surges, hospitals could develop programs similar to Children's Hospital Colorado's home oxygen therapy program for children with bronchiolitis.⁴³

In addition, telehealth can expand ED capacity. Early in the COVID-19 pandemic, a pediatric ED in Canada developed a "Virtual Pediatric ED" through which a child's guardian could schedule an urgent telehealth appointment and be referred for a typical ED visit or nurse-only visit if needed (eg, for urine testing).⁴⁴ Caregivers reported high satisfaction with this program and most indicated that, without this virtual care, they would have presented to the ED.⁴⁴ Another pediatric ED employed telehealth screening evaluations upon ED arrival whereby a telehealth physician places orders and expedites patients' ED workups.^{45,46} Given the feasibility of such initiatives,^{44,45} we recommend that during pediatric surges EDs consider implementing virtual ED programs and offering patients in the waiting room the option to have telehealth visits on site.

In addition to expanding telehealth, hospitals can expand the footprint of EDs or inpatient wards through the development of tents or field hospitals to care for low acuity patients. During the 2009 H1N1 pandemic, one children's hospital developed space in an outdoor parking lot to efficiently care for low-acuity patients with H1N1 symptoms.⁴⁷ When there is an even greater capacity crisis, creation of field hospitals, such as those that were developed for COVID-19 patients, could be considered.^{12,13}

2.3.2 | Staff

Health systems can increase pediatric staffing in several ways. First, in the short term, hospitals can offer moonlighting opportunities. This was a widely reported strategy during the H1N1 pandemic, but one study raised concerns about the sustainability of using moonlighting during a longer surge.¹⁶

Another approach is for hospitals to expedite re-credentialing of recently retired pediatricians. The recently retired workforce could staff telemedicine visits, which would not put them at risk for illness. Support can also be enlisted from clinicians with expertise in both adult and pediatric medicine, including those with internal medicine/pediatrics, family medicine, and emergency medicine training.^{10,17,35} Many respiratory therapists, physical therapists, and other clinicians may also have training in both pediatric and adult care, and hospitals should have a pathway for expedited credentialing to enable these health care workers to care for children.

Similarly, it is important during a surge for health systems to expedite approval of telemedicine credentialing to staff virtual ED visits and telemedicine consults. When children are cared for by teams that are

more accustomed to adult patients (eg, when older children are admitted to adult ICUs), it is important to have pediatric subspecialty physicians, such as pediatric intensivists, available for either in-person or telemedicine consultation.^{35,48} Teleconsultation could be used across institutions, such that children's hospitals can offer consults to community hospitals caring for children in the region, provided there is appropriate clarification of reimbursement and credentialing.³⁵ In addition to physician consults, telemedicine could also be used to facilitate pediatric nursing and respiratory therapy consultation.

2.3.3 | Supplies

Similar to state and local governments, pediatric referral centers should also maintain stockpiles of critical pediatric devices and pharmacotherapies.⁴⁸ For teams that less frequently care for children, we recommend use of color-coded supply carts such as those based on the Broselow length-based resuscitation tape.⁴⁹ Additionally, just as patients are transferred between hospitals based on capacity, hospitals could consider collaborations with other institutions to facilitate exchange of supplies—for example, to ensure that community hospitals have access to supplies such as high flow nasal cannula oxygen.

2.3.4 | System

It is critical for hospitals to develop prespecified criteria to guide which pediatric patients should be admitted to adult versus pediatric units. Criteria should enable PICUs to concentrate on the youngest and sickest patients and should also consider whether the indication for admission is common in adults versus specific to children.³⁵ Hospitals can consider if certain treatments often admitted to ICUs (eg, asthma on continuous albuterol) can be cared for on pediatric floors. PICU consultation and support from pediatric nurses and respiratory therapists could assist with implementing such initiatives safely.

Additional strategies to help preserve inpatient and ED capacity include optimizing use of urgent cares and sick visits in ambulatory pediatric clinics. Health systems could financially support extending clinic hours and increasing available sick visits.⁵⁰ Additionally, during a capacity crisis, patients in ED waiting rooms for a prolonged time may leave without being seen. Hospitals can consider digital solutions, such as developing a text messaging program to ensure these pediatric patients access care promptly and/or to offer telehealth visits when appropriate.

When pediatric capacity crises reach truly critical levels, one consideration is for hospitals to postpone at least some elective procedures, potentially in both pediatric and adult patients, similar to the Centers for Medicare & Medicaid Services recommendation early in the COVID-19 pandemic.¹¹ Additionally, routine well child visits might need to be deprioritized during a surge, in favor of maximizing available sick visits. In this case it will be important to continue increased outpatient capacity after the crisis, to prevent children from falling behind on preventive care such as vaccinations.

Finally, it is also critical for health systems to provide educational resources for clinicians who less commonly care for children, just as pediatricians received training to care for adult patients during the COVID-19 pandemic. Educational strategies include handbooks, tip sheets, and videos covering basic topics; “just-in-time” training by nursing educators; and multidisciplinary simulation sessions.^{10,51} To care for pediatric patients, adult-trained clinicians need to learn weight-based medication administration; age-based vital sign ranges; management of common pediatric illnesses (eg, bronchiolitis, croup); and legal and ethical considerations around consent, assent, and mandatory reporting for children.³⁵ Pediatricians also practice family-centered, developmentally appropriate care^{52,53} and often have more permissive visitor policies than those for adult patients.¹⁰ Additionally, clinicians should receive specific training on how pediatric advanced life support differs from advanced cardiovascular life support for adults, in the event they are caring for a patient who clinically deteriorates.

2.4 | Individual clinician strategies

2.4.1 | Space

Particularly during surges, it is important to prevent, when feasible, admissions for patients who could be safely treated outpatient and to limit referrals to the ED for diagnostics or treatments that could be completed outpatient. For ED physicians, physician assistants and nurse practitioners, just as it is important to recognize patients requiring transfer to other institutions for specialized care, it is equally valuable to identify patients located at tertiary care pediatric facilities who require admission but can safely be cared for at community hospitals with greater capacity. Hospitals can consider transferring to another local facility with an appropriate inpatient bed more readily available, a process called “level-loading,” which was employed in response to surges in adult volume during the COVID-19 pandemic.⁵⁴

2.4.2 | Staff

Health care workers with pediatric training can step forward to care for children to meet increased demand during a surge. For example, emergency medicine residency-trained physicians receive training in pediatric emergency medicine and could staff pediatric EDs. Hospital staff should be incentivized to work in the places where they are most needed and complete available just-in-time training to best prepare to care for these patients.

2.4.3 | Supplies

Individuals caring for patients during surges in volume should make efforts to conserve equipment. Those with less pediatric experience should seek out training to familiarize themselves with pediatric supplies including code carts, airway equipment, and common medications.

2.4.4 | System

During a surge, there will be numerous changes made in a short time to increase pediatric capacity, and health care workers should provide feedback on these changes so improvements can be made. For example, one study outlined steps taken in response to the initial COVID-19 surge at a medical center in New York and staff members’ feedback—including perspectives on staffing levels, practical challenges of caring for critically ill patients outside of ICUs, experiences with availability of critical supplies, and suggestions for additional system-level resources that would have been valuable.⁵⁵ Feedback from individuals can be aggregated and summarized on a regional or national level so health systems can learn from each other’s experiences.

3 | DISCUSSION

The response to the COVID-19 pandemic and associated surge of critically ill adult patients demonstrated that hospitals, health care systems, and clinicians can readily adapt and implement creative solutions to deliver the best care possible during a capacity crisis. Given the increased regionalization of pediatric care in this country in recent decades, it is imperative for policymakers, health care systems and clinicians to be prepared for a surge in pediatric patients.

Governments and health care systems must consider triggers and thresholds for activating surge responses. The National Academy of Medicine previously addressed the topic of thresholds for activation of “contingency” and “crisis” surge responses.⁵⁶ For instance, surge responses may be activated when wait time in EDs are longer than a given threshold, when inpatient pediatric bed capacity is below a certain threshold, and/or when the World Health Organization designates a pandemic.⁵⁶ Kelen et al propose a group of eight criteria and associated thresholds that warrant consideration of crisis standards of care, such as when an ED has a majority of beds used by ED boarders for at least one day, or scarcity of critical supplies.⁵⁷

It is also important to recognize limitations of the potential strategies discussed in this article. First, many of these strategies require additional funding, and policy changes are needed to allow hospitals to recoup costs, for example through expanded ability for emergency clinicians to bill for observation level of care and telemedicine consults. Governments can also offer grants, financial incentives, and subsidies to support proposed changes (eg, for supplies to expand telemedicine). As larger changes are considered to increase pediatric resiliency, improving payment models for pediatric patients should be a long-term goal to ensure hospitals have sufficient resources for emergency preparedness.

Additionally, leaders must recognize mental health implications for staff working during a surge. In qualitative studies, pediatric clinicians who worked in adult surge units during the COVID-19 pandemic described the stress of practicing outside their usual scope and moral distress around the fear of providing substandard care because they lacked training in adult medicine.^{51,58} Similar concerns would likely arise for adult-focused clinicians caring for children. However,

alongside the stresses of caring for adults during the COVID-19 surge, pediatric clinicians found meaning in caring for patients during a global pandemic and expressed pride in discovering they were “more flexible and adaptable than [they] would have thought possible.”⁵³

Finally, another important limitation in applying strategies used in the early COVID-19 pandemic is that this surge in adult patients with COVID-19 was associated with a decrease in the volume of pediatric patients and overall ED visits in the United States.^{44,59,60} A pediatric surge that occurs with coincident adult capacity challenges, such as the current ED boarding crisis,^{5,59} can limit the ability to redirect space, staff, and supplies from regions of the hospital that care for adults. Future research is needed to understand how to optimize systems of patient flow, preserve high-quality care during capacity crises, and develop novel systems of just-in-time training for this and future crises. Despite these limitations, preparations regarding space, staff, supplies, and the system are each critical in response to a surge, and the strategies discussed in this article can be considered by policymakers and health systems to guide future pediatric preparedness.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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