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Strategic Surge Responses in the COVID-19 era: Operational Themes, Innovative Solutions and Lessons Learned by Three Freestanding Pediatric Emergency Departments

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Abstract

The prolonged COVID-19 pandemic has created unique and complex challenges in operational and capacity planning for pediatric emergency departments, as initial low pediatric patient volumes gave way to unpredictable patient surges during Delta and Omicron variants. Compounded by widespread hospital supply chain issues, staffing shortages due to infection and attrition, and a concurrent pediatric mental health crisis, the surges have pushed pediatric emergency department leaders to re-examine traditionally defined clinical processes, and adopt innovative operational strategies. This study describes the strategic surge response and lessons learned by 3 major freestanding academic pediatric emergency departments in the western United States to help inform current and future pediatric pandemic preparedness.

Introduction

Patient volume surges outside of typical seasonal variation in the pediatric emergency department (PED) can be difficult to prepare for and cause significant operational challenges. The 2009 H1N1 influenza outbreak was the last major pandemic to cause a national surge in PEDs, disproportionately affecting patients younger than 25 years,¹ and exposing gaps in PED preparedness. A 2011 national survey of PEDs reported that 40% did not have pandemic preparedness plans and many PEDs developed plans as a result of the H1N1 outbreak. Most plans were limited with some addressing surge staffing and alternate care sites.²

More than a decade later, PEDs across the country experienced patient surges in the midst of the virulent Delta and Omicron variants of the COVID-19 virus in 2021 and 2022. Unique factors associated with the COVID-19 pandemic have created different and more complex challenges than prior pandemic surges, due to unpredictable fluctuations in pediatric volumes and lingering downstream effects.³ Unlike H1N1, the prolonged COVID-19 pandemic has led to widespread hospital supply chain issues⁴ and staffing shortages due to high rates of staff infection,⁵ burn-out, and attrition.⁶ Additionally, the isolation and burden created by COVID-19 has led to a concurrent rise in pediatric mental health visits to the emergency room, which was declared a national emergency and further worsened the overcrowding of PEDs.⁷

While the majority of PEDs responded to H1N1 by increasing staffing and physical capacity by creating alternative care sites,² the unique aspects of the COVID-19 era have challenged institutions to re-evaluate and change fundamental operational practices. Learning from these new adaptive strategies will ultimately improve the breadth and resilience of pandemic preparedness for PEDs. In this report, 3 major freestanding academic PEDs share common themes and lessons to help inform current and future surge responses. These departments have re-examined traditionally defined clinical processes and roles to manage high patient volumes compounded by reduced staffing and limited hospital capacity. This report presents a menu of sustainable operational changes that could be applied across multiple contexts in response to a prolonged surge. It also highlights major challenges and opportunities requiring a broader discussion from the larger healthcare community to optimize pediatric patient care in the midst of a surge crisis.

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Table 1. Overview of the 3 major freestanding academic pediatric emergency departments represented in this report

	PED Size	PED Annual census	PED Surge committee members
Seattle Children's Hospital	38 beds	2020: 34584 2021: 43000 2022: 60305	<ul style="list-style-type: none"> • PED nursing, physician, APC leadership, and staff • Mental health leadership and staff • Unit coordinators • Hospital leadership, infection control, information technology
Children's Hospital Los Angeles	37 beds	2020: 62454 2021: 76891 2022: 95693	<ul style="list-style-type: none"> • PED nursing, physician, APC leadership, and staff • Hospital leadership, command center, facilities and information technology leadership
Children's Hospital Colorado	48 beds	2020: 48000 2021: 64000 2022: 77300	<ul style="list-style-type: none"> • PED nursing leadership and staff • PED physician, APC leadership, and staff • Hospital leadership, information technology, emergency management, and facilities

Note: *APC, Advanced Practice Clinicians

Context

The 3 PEDs represented in this report are major freestanding academic pediatric centers located in the western United States (Table 1). Similar to other pediatric institutions around the country, all 3 experienced sharp drop offs in patient volumes during the initial Covid-19 pandemic (March – June, 2020), with lower than historical volumes persisting through June, 2021 (Figures 1, 2, and 3). Patient volumes started to substantially increase in the second half of 2021, with surges coinciding temporally with the rise of the Delta variant at SCH and CHLA. Volumes at SCH and CHCO continued to surge in the first few months of 2022 beyond historical pre-pandemic volumes. Figures 1–3 show the tremendous variability and departure from historical trends within the past 3 years, underscoring challenges in operational planning. This unpredictability has been further compounded by significant nursing and staff turnover within the same time period,^{5,6} forcing PEDs leadership to adopt innovative operational strategies.

Major themes and lessons

New clinical models of care

With increasing patient volumes and reduced staffing, the PEDs in this report have implemented new models of care to improve throughput while optimizing resource utilization. Compared to traditional processes, these innovative models offered more flexibility and adaptability of workflow processes for targeted patient populations. A common goal was to safely expedite patient assessment and disposition by limiting emergency department (ED) footprint and streamlining standard patient and provider touch points.

Seattle Children's Hospital (SCH)

SCH adopted the Rapid Medical Assessment (RMA) Model commonly used in adult emergency care, which has been shown to decrease length of stay and time to provider.^{8,9} Patients meeting criteria (categorized as Emergency Severity Index level 3, 4 or 5, who likely need minimal ED resources) were quickly evaluated by an ED attending and/ or advanced practice practitioner in flexible spaces such as hallways or waiting areas, where diagnostics and treatments were initiated without undergoing step-wise triage and serial trainee evaluations. The SCH PED also liberalized discharge criteria for patients in whom test results would not change disposition; examples include patients awaiting rapid strep antigen

test, urinalysis, or viral studies. Such patients were discharged to the lobby or home while awaiting results. For those discharged home awaiting results, either the RMA team or the pre-existing communications center updated families and sent prescriptions as needed. The RMA model was also utilized for early care initiation for patients needing more extensive workup when an ED room was not immediately available. In this circumstance, patients were brought to a temporary space and had workup started (e.g., blood drawn, IV placed, imaging studies ordered, or medical clearance completed for mental health evaluation) and then returned to the ED lobby to wait for an ED room. Since these processes rethink the traditional flow of an academic ED, continued training and frequent check-in with staff were key to ensuring success of adoption and incorporation of iterative changes.

Children's Hospital Colorado (CHCO)

CHCO implemented a front end 'Intake' process in 2015, in which the triage rooms were converted to full patient care rooms in order for a physician to assess a patient as soon as possible after arrival to initiate and expedite their evaluation. When patients arrived at the PED they were initially met by a 'Sort' nurse who assigned an ESI level and determined the destination of the patient: to Intake or to the main area of the ED based on specific inclusion and exclusion criteria. A pediatric emergency attending evaluated patients in Intake and further determined whether they could be discharged to home after a quick intervention, required to be seen in the main area of the ED as a 'super track' patient that would likely be discharged within an hour, or became a 'main' ED patient that would likely require significant further evaluation and management. As patient volumes increased, and ED capacity decreased, there was a significant need to maximize the use of the front-end area to evaluate, manage, and discharge appropriate patients to preserve capacity in the main area of the ED. Increasing the use of standing orders (protocols that allow nurses and medical assistants to order certain clinical tasks without having to first obtain a physician order) further improved this process. This included ordering of X-rays for minor trauma, ondansetron for vomiting with diarrhea, and ibuprofen/ acetaminophen for pain and/ or fever. Additional interventions were taken to aid with discharge of patients who would otherwise have been determined to be 'super track.' This included the splinting of minor fractures in intake, providing oral rehydration after ondansetron while in the waiting room, and completing simple diagnostic procedures such as rapid strep swabs, viral respiratory testing, and urinalysis.

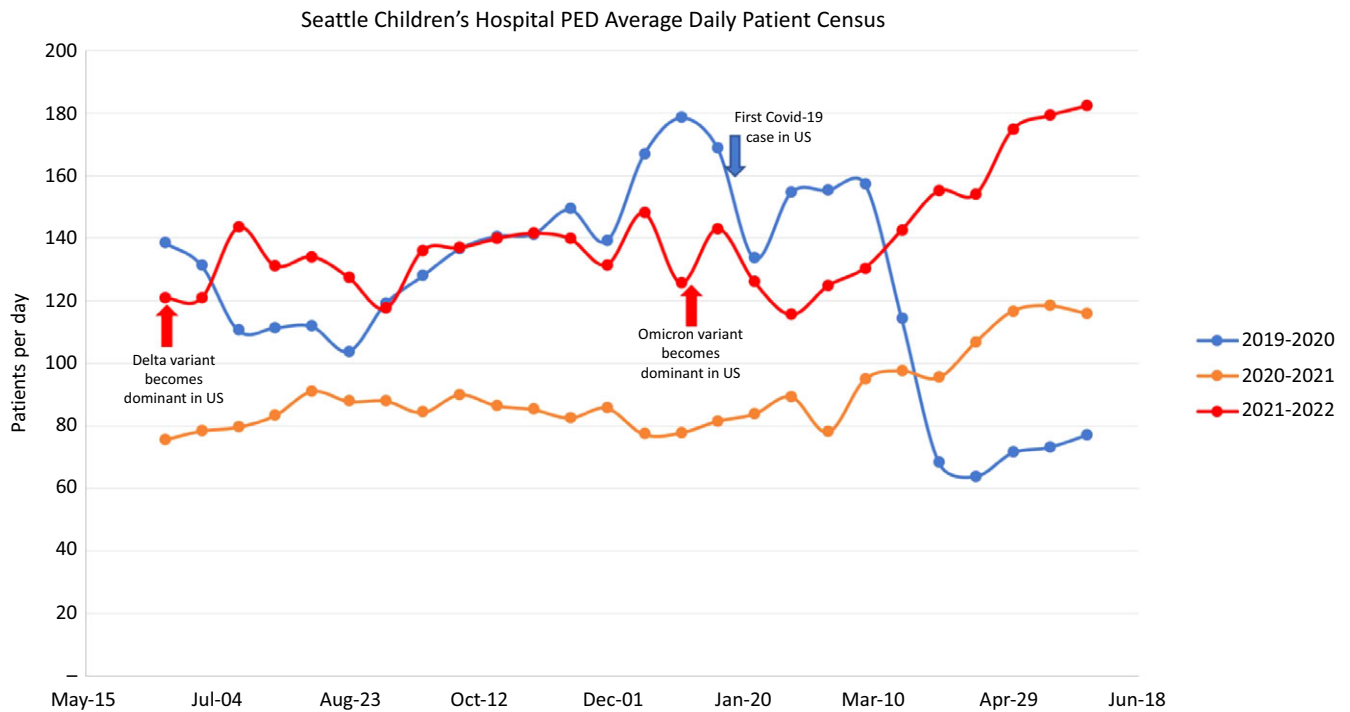


Figure 1. Averaged daily patient census in 2-week blocks for Seattle Children's Hospital PED from June 2019 through May, 2022.

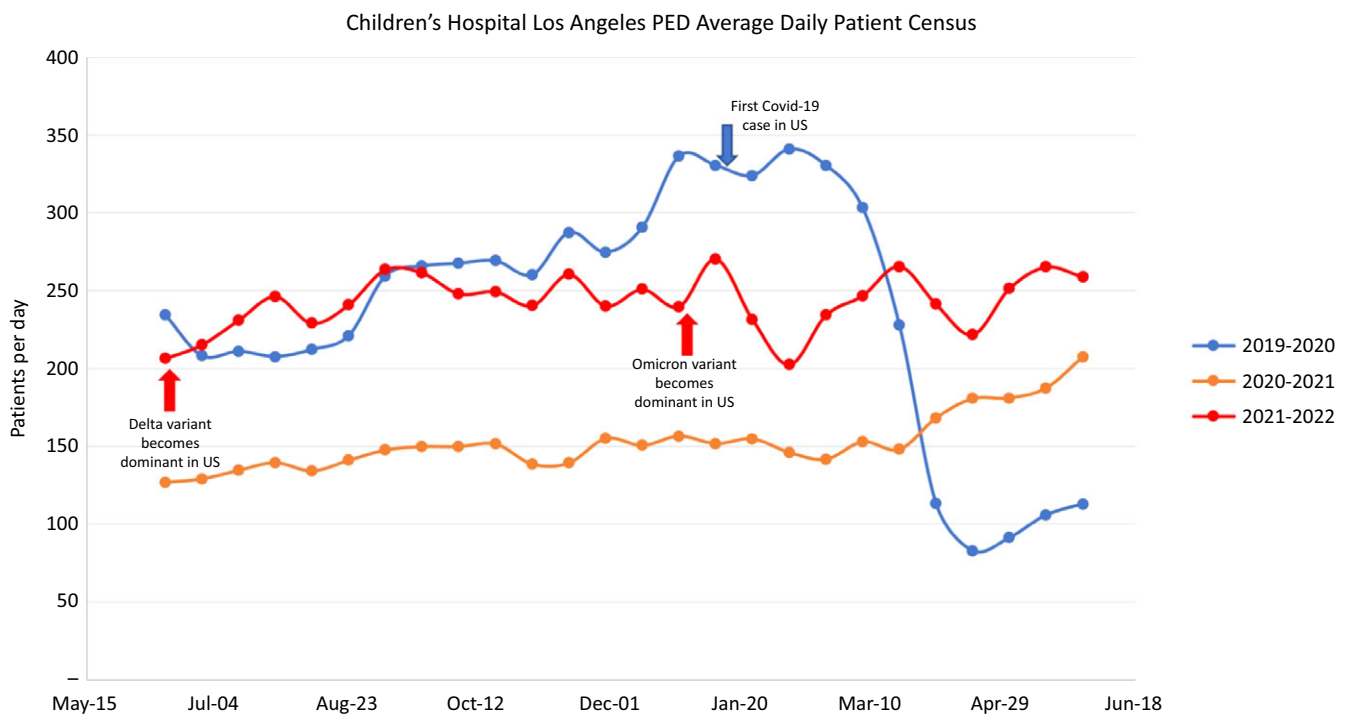


Figure 2. Averaged daily patient census in 2-week blocks for Children's Hospital Los Angeles PED from June 2019 through May, 2022.

Cross-departmental collaboration

The flow through the ED is intricately tied to the rest of the hospital, both in parallel, such as with radiology and pharmacy which the ED relies on for diagnostics and treatment, and in series

with downstream inpatient and subspecialty services that admit ED patients. Pre-emptive planning and agreement on operational contingencies across departments during surge activation proved to be a key aspect of the PEDs' surge response.

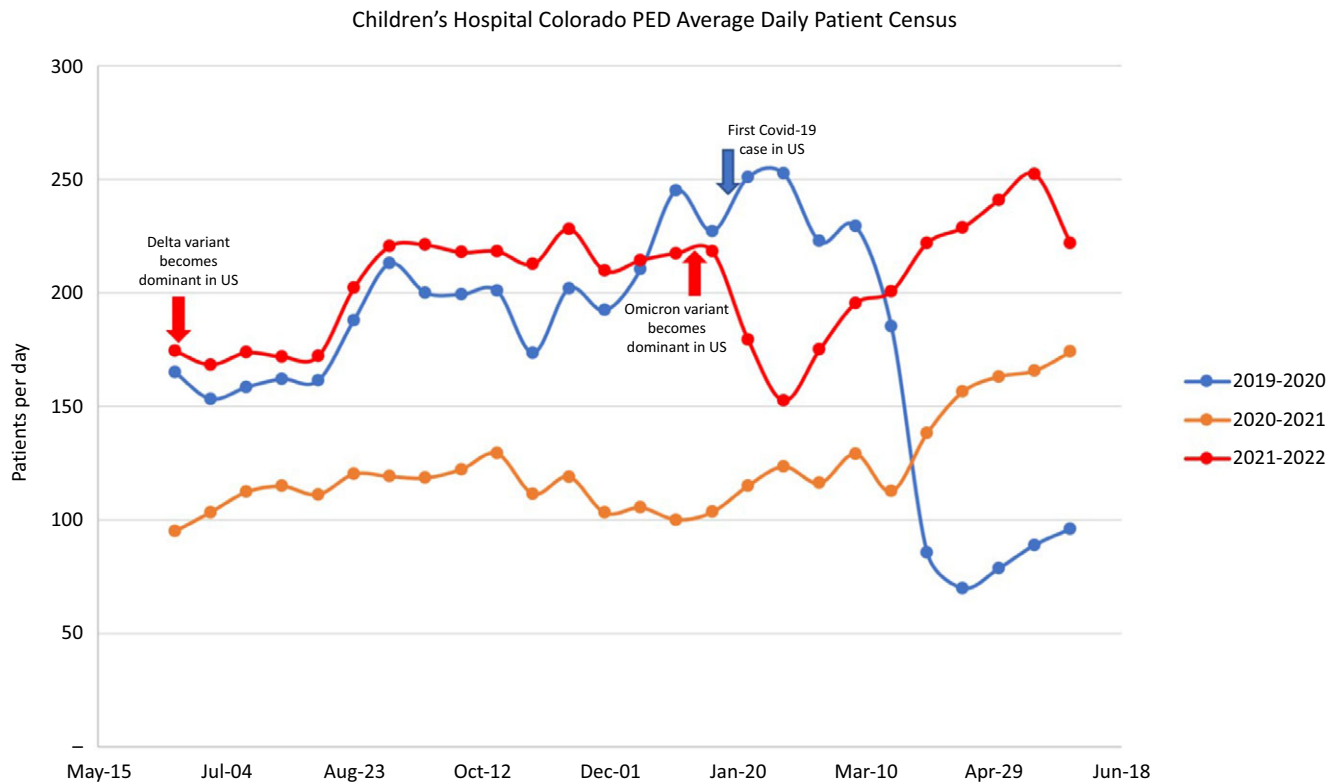


Figure 3. Averaged daily patient census in 2-week blocks for Children's Hospital Colorado PED from June 2019 through May, 2022.

SCH

At SCH, admission to the pediatric intensive care unit (PICU) previously involved a consult process for all potential patients meeting intensive care criteria. This consisted of an in-person bedside evaluation in the ED by an intensive care attending, fellow, or advanced nurse practitioner. Due to surge volumes, the PICU collaborated with the PED to implement a new expedited process which bypasses this consultation for patients meeting specific predetermined criteria, such as patients who are intubated, on inotropes, or newly started on positive pressure ventilation. Similarly, the disposition of patients to primary specialty service teams typically required subspecialty team acceptance prior to bed assignment. A previously designed but infrequently used 'admission matrix' model was revived to facilitate direct acceptance of patients meeting certain admission criteria to over 16 specialty services. For example, patients with new onset diabetes or adrenal insufficiency who met acute care criteria could start the admission process to endocrinology prior to detailed subspecialist consultation. For patients whose disposition was affected by delayed workup (such as an MRI), the general medicine service agreed to accept them prior to completion of the study.

SCH PED leadership increased notification of ED surges to key operational leaders (such as radiology, pharmacy, and inpatient departments) to improve situational awareness among departmental leaders and offload PED needs during active surge. For example, an inpatient nurse could be assigned to pick up their patient directly from the ED instead of waiting for ED transport. Several actions were linked with the surge alert including the ED team placing admit orders and additional nurses from the hospital being sent to the ED to assist. Cross-departmental staffing shortages have limited this strategy's impact.

Children's Hospital Los Angeles (CHLA)

Similar to other hospitals, admission of a patient from the ED at CHLA to an inpatient unit was a complex, multi-step process. The workflow for admissions during the pandemic was revisited and scrutinized to reduce redundancies, eliminate unnecessary steps, and improve efficiency. Instead of steps that were done sequentially, some steps were performed simultaneously, such as giving phone sign out by physicians and nurses to their respective inpatient counterparts. In addition, the work that environmental services provide to clean a room before a new patient can arrive was streamlined by making certain supplies accessible on each unit of each floor instead of one centralized storage area.

Another example of collaboration across departments at CHLA was the creation of the 'ED Length of Stay (LOS) Alert,' intended to trigger a house-wide alert to assist with ED decompression. The CHLA ED used a modified version of the National Emergency Department Overcrowding Scale (NEDOCS). When the NEDOCS score reached 140 ('overcrowded'), an ED LOS Alert was triggered whereby ED patients who were waiting for COVID results before being assigned an inpatient bed were sent up as patients pending infectious status prior to the COVID result. The pandemic also allowed for improved collaboration between the ED and other subspecialists on patients who did not require admission but who were seen in the ED and needed close outpatient follow up. For example, with uncertainty about new disease processes such as Multisystem Inflammatory Syndrome in Children and Post-COVID Vaccine Myocarditis, new protocols were developed with Cardiology to ensure standardized ED testing and management of such patients, as well as adequate post-ED care while balancing ED throughput and staffing constraints.

Workload balancing and resource allocation

Staffing shortages due to COVID-19 infection, burnout, and attrition has created significant ongoing operational challenges for all 3 PEDs. These institutions have mobilized and utilized existing staff to fill in gaps while avoiding overburdening the current workforce. A key solution has been workload balancing among members of the PED team and the rest of the hospital. These teams have remained nimble and flexible in allocating resources across the department and the entire hospital.

At both SCH and CHLA, medical providers helped with nursing tasks such as entering vitals and discharging patients. Respiratory therapists were encouraged to assist with IV access, EKGs, or transport. CHLA PED hired licensed vocational nurses for the first time and developed guidelines for practice scope in lower acuity zones. CHCO PED allowed internal Emergency Medical Technicians (EMTs) to expand their scope of practice and assist with blood draws and IVs, as well as assist with 1:1 watches with behavioral health patients.

At CHLA, the ED procedural sedation policy was modified such that for orthopedic sedations, the RN was present for induction only, while the MD remained in the room for the entire sedation, giving additional doses of sedatives if needed and completing the documentation. This represented a change in their previous sedation workflow when both the MD and RN remained in the room for the entire sedation, and was approved by the appropriate hospital committees. Since implementing the new sedation policy over 1 year ago, there has been no increase in adverse outcomes. CHCO made strategic decisions to close lower volume sites, including a small community-based ED, and relocated staff to busier clinical sites. SCH PED leadership created new incentive systems to upstaff residents, nurses and mental health staff, and increased hiring of new staff.

Physical capacity expansion

A core pillar of surge management is the expansion of physical capacity to accommodate patient surges in real time. Just as the 3 PEDs learned to quickly mobilize resources and staffing in times of need, they also developed processes for expanding patient care spaces for surges.

SCH, CHLA, and CHCO PEDs all procured medical grade tents to expand physical capacity for direct patient care. Specific criteria, including ED census and appropriate staffing, were used to determine activation of these additional spaces. Patients assigned to ESI level 4 or 5, with minor trauma or infections, were considered for the tent. At SCH, existing storage spaces and hallways were swiftly converted to patient care areas using portable equipment such as computers on wheels, supply carts, and portable oto/ ophthalmoscopes. At CHCO, the procedure center of the post-anesthesia care unit (PACU) adjacent to the main PED, typically used by surgical and sub-specialty services during daytime hours, was repurposed by PED staff during evening hours as patient care space. Patients with ESI levels 3, 4, or 5 and expected to need focused evaluations and interventions were escorted to the procedure center by an EMT or RN. A cart including IV, point of care lab and splinting supplies was stocked and brought to the procedure center nightly.

Mental health crisis

A difficult aspect of the COVID-19 pandemic is the concurrent pediatric mental health crisis. Weekly ED visits, especially among

adolescent females, increased drastically from 2019 through 2021.⁷ Many presented with concerns of suicidal ideation, which resulted in significantly prolonged lengths of stay in the ED while awaiting admission to inpatient psychiatry units. This patient population posed special challenges in the context of surge given its high acuity and unique needs. The PEDs in this report implemented specialized pathways to address these needs.

SCH

SCH PED implemented a bundle of operational and clinical tools to streamline care for patients presenting with mental health concerns. Physicians had historically relied on a team of specially trained Mental Health Evaluators (MHEs), who are professionals with Masters' degrees in social work or counseling, for behavioral and safety assessment of patients, as well as for determining final disposition. This core team has proven to be essential in times of mental health patient surges. To streamline and improve collaboration between providers and MHEs, a mental health handoff tool to specify where each patient was in their evaluation process was created in the electronic health record to facilitate communication of care progression, barriers, and disposition. Given the frequently high volume of mental health boarders in the PED, a daily huddle with walk rounds was initiated with hospital and inpatient psychiatry leadership to review boarding mental health patients in the ED. A decommissioned space in the main hospital was redesigned, modified and simulated to be a calm, quiet boarding area for mental health patients awaiting inpatient psychiatry placement. This space was staffed by PED attendings, nurse practitioners, nurses and security officers. The main ED rooms are designed with a porch allowing visibility into two patient rooms from one spot; trained watch staff are able to complete 2:1 watch assignment. An overflow space was briefly opened where 6 lower acuity mental health patients were co-located using 2-3 staff members.

CHLA

All patients requiring inpatient psychiatry bed placement were transferred out, given that CHLA does not have its own inpatient psychiatry unit. Difficulty in outside placement due to lack of availability of psychiatry beds has been a long-standing issue, and was now further compounded by the mental health crisis. The PED continued to admit patients on psychiatric hold for more than 24 hours to the general medicine service if psychiatric placement could not be obtained within the timeframe.

CHCO

CHCO implemented a mental health patient surge plan for psychiatric emergency services for the main campus PED as well as the 2 CHCO network PED sites. Triggers to initiate the boarding patient surge plan included community mental health beds nearing capacity, CHCO inpatient psychiatric beds at capacity, and location specific triggers of total number of mental health patients present, number of boarding, or extended stay patients. Once triggers were met, a huddle was organized by ED leadership and consisted of ED Behavioral Health Counselors (BHCs), ED physician and nursing leadership, inpatient physician and nursing leadership, and nursing house supervisor. The BHC identified patient(s) who would be best supported in a secondary location such as an inpatient medical unit, or another CHCO ED location.

Considerations when determining which patients were safe and appropriate for the inpatient medical setting included behavioral observation level, use of seclusion or restraints, medical

complexity, and aggressive behaviors, as well as history of elopement or impulsive behaviors, behavioral or development diagnoses, or active high-level self-harm. Strict attention was paid to the overall capacity of inpatient medical units so as to not overload these units with mental health patients and prohibit admission of medical patients.

In January 2022, CHCO announced the appointment of its first 'Mental Health In-Chief' across the entire hospital system. Like more traditional 'Pediatrician In-Chief' and 'Surgeon In-Chief' roles, this new role became a critical partner to help shape the mental health vision, strategy, operations, and safety of the entire CHCO system, aiming to integrate pediatric mental health into all major hospital level decisions.

Discussion

The prolonged and unexpected course of the COVID-19 epidemic has continued to test the institutional stamina of PEDs. The collective surge response of the PEDs represented in this paper highlights major challenges and opportunities that warrant further discussion by the larger healthcare community to improve future surge preparedness.

Communication and patient safety

Communication challenges are frequently cited as factors contributing to confusion and miscoordination during large scale disaster responses.⁹ In the context of the prolonged and unexpected course of the COVID-19 pandemic, many hospitals' emergency management, infection prevention, and control teams came to the forefront of daily operations. Initial periods of information overload with constant change in policies and practices gave way to centralized communication via hospital wide incident command systems. Centralizing communication allowed the command centers to prioritize what information was shared, with whom, and when, while being mindful to not overburden staff at any one point in time. Incident command also served as a comprehensive repository of updates, protocols, training resources, and important points of contact.

Early in the pandemic, the institutions in this paper experienced shortages in personal protective equipment (PPE), a trend seen nationally,^{11,12} and prioritized PPE resources for high exposure and procedural units like the ED. Over time, supply-chain issues and changing PPE guidance continued to pose a challenge for consistently maintaining best protective practices. The uncertain transmissibility of each COVID-19 variant surge, as well as a high proportion of asymptomatic pediatric patients, complicated the segregation and cohorting of patients and caregivers. During surges and staffing shortages, throughput issues like delays in check-in and triage, and increased left without being seen rates was worsened by crowded waiting rooms.

A fundamental principle underlying the surge response is the need to balance patient safety and outcomes with efficiency and flexibility. While many of the strategies and initiatives described aim to push the status quo in terms of process and flow, strong centralized communication and understanding of practice limitations is key to ensuring that patient safety is never jeopardized. As such operational interventions rethink traditional processes, it is even more important to closely monitor balancing measures and patient safety metrics.

The PED within the larger hospital system

The unique position of the PED as the only unit in the hospital without an option for diversion calls for a deeper dive into resource allocation across the hospital system, especially during patient surges. The ED is a shared resource, where primary doctors and specialists refer patients for rapid evaluations and work-ups, leading to concentrated geographic risk-pooling. There is a constant struggle to balance staffing shortage across the hospital system while minimizing safety risk in the ED. Most EDs base their planned staffing levels on historical volumes (i.e., for a particular time of day, day of the week, or month of the year). During surges that overwhelm ED capacity to safely care for patients, it is often necessary to increase staffing levels for short or sustained periods. Recognizing that most EDs do not have unlimited reserves of unit-specific staff and providers who can step in during sustained surges, hospital leaders can help support these staffing efforts. This may include increasing incentive pay for overtime coverage, moonlighting opportunities, or reassigning cross-trained staff and providers from other areas to help manage certain subsets of patients. The key for hospital leaders is acknowledging that the ED may not be able to shoulder the full burden of the patient surge without support.

A significant contributor to ED overcrowding is the lack of inpatient access with both medical and mental health patients boarding in the ED while awaiting placement. This has been shown to negatively impact ED operations and patient care.¹³ The time patients spend in the ED while awaiting an inpatient bed is typically referred to as 'ED boarding time,' although the boarding is a hospital problem. Hospital leaders should prioritize, especially during active surge, minimizing ED boarding time by incentivizing early inpatient discharges, re-evaluating elective admissions and surgeries, and enacting a flow center to guide hospital wide flow. Additionally, with the rise in mental health visits and increase in patients waiting in PEDs for mental health placement, there is an urgent need for improved access to inpatient facilities, intensive outpatient programs and other system-level solutions.

General emergency medicine community

COVID surges affected general emergency departments (which primarily serve adult populations) similarly but on different timelines from PEDs. Initial pandemic waves in 2020 saw high volumes in adult pandemic epicenters, while other general EDs saw declines in ED volume and non-COVID cases due to widespread lockdowns.¹⁴ This coincided with low volumes at PEDs due to school quarantines and closures. As the pandemic progressed, Omicron and Delta waves caused similar surges in general ED volumes as PEDs, revealing similar levels of unpredictability. Staffing shortages and supply chain issues also played a significant role, while the youth mental crisis was more prominent for PEDs.¹⁵ Notably, prior to the pandemic, the boarding of pediatric patients, including for mental health concerns, was much less than adults; now there is a new acceptance of longer wait times and boarding of pediatric patients. Although much has been published regarding surge response and lessons in operations for general EDs, most of the solutions discussed here can be generalizable to EDs for any age group with few modifications.

Conclusion

The past 2 years of the COVID-19 pandemic has created tremendous burden for the healthcare system, with initial low

pediatric numbers giving way to a surge in both pediatric medical and mental health patients. The persistent overcrowding compounded by critical staffing shortages in the PED has provoked a sense of urgency and drive for institutional change and response. Operational leaders at 3 major freestanding PEDs have re-examined traditional clinical processes and resource/staffing deployment, created close collaboration across departments within the hospital, and implemented creative solutions for physical capacity expansion. Their collective surge experience highlights the importance of centralized communication and balancing patient safety with increased efficiency and throughput. Most importantly, the operational themes show that a robust surge response in the PED is reliant on a team approach from the rest of the hospital, including support from hospital leadership and collaboration from all other departments within the hospital system.

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Abbreviations. BHC, Behavioral health counselor; CHCO, Children's Hospital Colorado; CHLA, Children's Hospital Los Angeles; ED, Emergency department; EMT, Emergency medical technician; LOS, Length of stay; MHE, Mental health evaluator; NEDOCs, National emergency department overcrowding scale; PACU, Post anesthesia care unit; PED, Pediatric emergency department; PICU, Pediatric intensive care unit; PPE, Personal protective equipment; RMA, Rapid Medical Assessment; SCH, Seattle Children's Hospital

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