Pediatric emergency mass critical care: The role of community preparedness in conserving critical care resources

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Introduction: **Public health emergencies require resources at state, regional, federal, and often international levels; however, community preparedness is the crucial first step in managing these events and mitigating their consequences, particularly for children. Community preparedness can be optimized through system-wide planning that includes integrating multiple points of contact, such as the community, prehospital care, health facilities, and regional level of care assets.**

Citizen readiness, call centers, alternate care facilities, emergency medical services, and health emergency operations centers linked to community incident command systems should be considered as important options for delivery of population-based care. Early collaboration between pediatric clinicians and public health authorities is essential to ensure that pediatric needs are addressed in community preparedness for mass critical care events.

Methods: **In May 2008, the Task Force for Mass Critical Care published guidance on provision of mass critical care to adults. Acknowledging that the critical care needs of children during disasters were unaddressed by this effort, a 17-member Steering Committee, assembled by the Oak Ridge Institute for Science and Education with guidance from members of the American Academy of Pediatrics, convened in April 2009 to determine priority topic areas for pediatric emergency mass critical care recommendations.**

Steering Committee members established subcommittees by topic area and performed literature reviews of MEDLINE and Ovid databases. The Steering Committee produced draft outlines and convened October 6–7, 2009, in New York, NY, to review and revise each outline. Eight draft documents were subsequently developed from the revised outlines as well as through searches of MEDLINE updated through March 2010.

The Pediatric Emergency Mass Critical Care Task Force, composed of 36 experts from diverse public health, medical, and disaster response fields, convened in Atlanta, GA, on March 29–30, 2010. Feedback on each manuscript was compiled and the Steering Committee revised each document to reflect expert input in addition to the most current medical literature.

Task Force Recommendations: **The Pediatric Emergency Mass Critical Care Task Force recommends active promotion of programs to ensure an informed citizenry; education of children and families in Centers for Disease Control and Prevention community mitigation strategies; emphasis on community-level preparedness empowering the public to provide self care; use of 9–1-1 telephone triage with pre-established protocols and in coordination with emergency medical services; and advocacy for healthcare coalitions and other creative operational concepts that provide guidance and protocols for care of the pediatric population. (Pediatr Crit Care Med 2011; 12[Suppl.]:S141–S151)**

KEY WORDS: alternate care facilities; call centers; children; citizen readiness; community preparedness; emergency mass critical care; health emergency operations center; pandemic; system-wide approach

Traditionally, a "community" can be considered an organized group of interacting people living in social cohesion, with common governance and in a common location. It is assumed that communities provide essential social and physical public health protections and access to basic health care. The large majority of conventional disasters in the developed and developing world are managed well by local community resources. In contrast, major catastrophic crises, whether they be epidemics, pandemics, extensive mass casualty events, climate change, large-scale natural disasters, or prolonged political conflict and war, have the potential to result in complicated public health emergencies (PHEs) arising from destroyed, inadequate, or overwhelmed public health infrastructures (water, sanitation, shelter, health, food, fuel) and/or systems (1). Whereas conventional disasters cause "direct" deaths and injuries, PHEs may result in extensive "indirect or excess" mortality and morbidity from failing or inadequate public health resources. Com-

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munities, both large and small, are not prepared to manage all-hazard PHEs without outside assistance (regional, national, and international).

Community preparedness is a crucial first step in managing PHEs and mitigating their potentially deadly consequences, especially for vulnerable populations and those with special needs. Community and provider engagement with state, local, and tribal governments should partner with and work to ensure strong public engagement of community and provider stakeholders in: developing and refining crisis standards of care protocols and implementation guidance; creating and disseminating educational tools and messages to both the public and health professionals; developing and implementing crisis communication strategies; developing and implementing community resilience strategies; and learning from and improving crisis standards of care response situations.

Preserving the lives of children during a PHE will mean guaranteeing appropriate access to scarce healthcare resources. The public health, medical, and mental/behavioral health community as a whole will be absorbed in ethical and triage decisions that are both uncomfortable but real (see the articles, "Treatment and triage recommendations for pediatric emergency mass critical care" and "Ethical issues in pediatric emergency mass critical care"). How successful these decisions will be in promoting the survival and well-being of children depends on how well public health, medical, and mental/behavioral health community preparedness efforts before, during, and after the PHE will mitigate the degree and consequences these decisions will bring. To illustrate the myriad of community challenges and strategies for mitigation (2, 3), this manuscript is focused primarily on pandemics; however, the preparedness aspects discussed here apply to all PHEs. With a pediatric and pediatric community focus, much of what follows supports guidance provided by the 2009 Institute of Medicine Crisis Standards of Care Report (4).

In a letter to members of the American Academy of Pediatrics on December 14, 2009 (5), President David T. Tayloe wrote that pediatricians need to be leaders in the effort to evaluate and augment community resources for access and treatment, and outlined what the pandemic environment would demand in action steps to be taken. This is timely, for it comes at a point when clarity and leadership is needed, especially at the local community level. Furthermore, leadership at the public health, medical, and mental/behavioral health community level may decrease the demand for critical care resources, which are already near capacity.

The May 2006 White House Pandemic Plan declared that the federal government has an "advisory role," emphasizing that local communities "bear ultimate responsibility for themselves" (6). Yet even today, the mindset of many communities is that scarce resources will readily appear as a federal "rescue." This is significant because pandemics begin and end at the local level, yet the knowledge base on epidemics and pandemics and how they impact children and families at the community level is severely lacking (3). Gaps and challenges are many. Children, as a recognized "at-risk," "vulnerable," or "special needs" population (7), may have the highest disease burden within a community and be disproportionately represented as victims in pandemics, such as seasonal influenza A and 2009 Pandemic Influenza A/H1N1, compared to the demographics in which they live. Children have innate physiologic and social vulnerabilities that contribute to morbidity and mortality, yet exact disease-specific data are often not available.

During the 2009 Influenza A/H1N1 outbreak, there was much improved preoutbreak community preparedness compared to the 2003 severe acute respiratory syndrome (SARS) pandemic. Pandemic preparedness plans were in place in 74% of countries when the pandemic began (8). In New Zealand and Australia, antiviral medications, new oxygen delivery methods, and modern day intensive care unit (ICU) care mitigated severity and improved outcomes in many young patients (9). With this success, and the fact that there was no coseasonal influenza A pandemic, communities have come to expect that a successful outcome will be the norm for every infectious disease outbreak. Unfortunately, in many communities, public education was lacking, with only one third of the population persuaded to be vaccinated, including healthcare personnel, a situation that could adversely impact any third-wave event. Whereas the development, manufacturing, and testing of the vaccine was excellent, distribution at the local level was poor (10, 11).

Historically, our knowledge base and skills in managing conventional disasters has emanated from generations of substantive "bottom-up" experiences that both drive and guide planning and preparedness. This is aptly demonstrated in our responses to major conventional disasters, such as earthquakes, hurricanes, tornadoes, floods, and fires. In contrast, our existing knowledge base and response for pandemics primarily arose from "top-down" plans that emphasize vaccines and strategic national stockpiles of scarce resources (3). Since the United States had been fortunate not to have experienced a pandemic in almost a century, this is fully understandable. The National Response Framework approved by the Federal Emergency Management Agency in 2009 is the clearest indication yet that the federal government has committed the full involvement of all levels of government in the planning response and recovery of catastrophic PHEs (12). Specific plans, such as the national anthrax-response plan, have also incorporated local communities in the development of Points of Distribution as adjuncts to critical capacities and the timely dispensing of prophylactic antibiotics and other resources during an infectious disease outbreak.

Severe pandemics produce many critically ill patients. Critical care resources on any given day are already functioning at or near capacity. Traditional approaches to conventional disasters, such as evacuation of patients outside the affected area, will simply not be an option during an overwhelming and geographically large PHE. Nothing will be more compelling than the impact faced by children, families, and their providers. This article addresses the role of community preparedness in establishing and empowering resilience and in mitigating the transmission of disease. In doing so, it ensures greater opportunities for critical care to reach a larger population of children.

Optimizing the community response

Healthcare providers are trained to optimize individual care. When a pandemic occurs there is a shift to population-based care to protect the greater number of victims who have the opportunity for survival, a tried and tested strategy sanctioned by public health declarations and law. This does not minimize

the importance of clinical tasks but rather adds the dimension of new public health and surge-capacity interventions and tools that improve overall access and availability of limited resources for the entire population (13). It is imperative that there is bilateral engagement of the public health workforce and public health authorities and emergency planners before a crisis occurs to ensure pediatric needs are being addressed. This particular recommendation has been cited as a priority standard in the March 2011 release of the Centers for Disease Control and Prevention's "Public Health Preparedness Capabilities: National Standards for State and Local Planning" (14) under the Community Preparedness capability section: "written plans should include documentation that public health has participated in jurisdictional approaches to address how children's medical and mental/behavioral healthcare will be addressed in all hazard situations." Pediatric professionals must be focused on both population-based and individual care when a pandemic occurs and serve a vital role as subject-matter experts and advocates. This expectation is again highlighted in the Public Health Preparedness Capabilities: National Standards for State and Local Planning, under the Medical Surge capability section, as jurisdictions are required to document how "participation from jurisdictional and regional pediatric providers from a variety of settings is utilized in jurisdictional response planning to address gaps in the provision of pediatric care and plans to access pediatric medical providers or liaisons for clinical care consultation." Success on both fronts depends on the collaborative effort of both professions to reduce morbidity and mortality. Pediatricians, pediatric critical care specialists, allied health professionals, and others in the community represent the physical and social protections and needs of children and families. Community and provider engagement, education, communication, and active collaboration with the public and stakeholders for their input are essential through formalized processes. For example, a network of pediatricians in Texas undertook an initiative to increase Houston's surge capacity during the 2009 Influenza A/H1N1 Pandemic. Four categories of interventions were utilized: enhanced communications between clinicians, families, and an affiliated tertiary care children's hospital that allowed for the efficient coordination of resources as well as a unified and consistent message; increasing community pediatrician presence; efficient vaccine distribution; and targeted viral diagnosis and antiviral utilization (15). Such measures can be adapted for other PHEs requiring increased community surge capacity.

In catastrophic PHEs, such as pandemics, all individuals in the population share the following: they have the same condition or are susceptible to it, have shared healthcare needs, and require some intervention. Indeed, the nonexposed but susceptible population often demands the bulk of educational and risk communication needs early in the course of a pandemic because only with decreased transmission can the pandemic be controlled (13). Yet, information for optimizing access and availability of care in a surge and resource allocation is often deficient at the community level. Although greatly improving in some states, others remain inconsistent and fragmented in surveillance, investigatory, and reporting capacity (16–18).

The importance of children in the spread of influenza and other viral pathogens in a population was recently confirmed in a community-based randomized study where vaccination not only protected children but conferred a large protective effect among unvaccinated community members (61%). When shortages occur, vaccination of children, in addition to other high-risk groups, must be a high priority (19).

Healthcare providers should understand that issues of viral transmission as it relates to pandemics are indicated through the transmission rate (R_0). This is the mean number of secondary infections, from one infectious case, in a population with no immunity. An $R_0 > 1$ defines an epidemic; $R_0 = 1$ occurs when the disease is endemic; and an $R_0 < 1$ means the disease will eventually disappear. If people become immune or are protected, R_0 will fall below one and the epidemic will eventually die out (8). Outbreaks tend to progress more slowly and lead to a relatively small number of cases if the basic R_0 is small. Influenza may spread rapidly because it has a very short generation time, even if it has a low R_0. High epidemic peak values and large cumulative numbers of cases are reached if R_0 is high and if the infection is highly contagious at the onset of symptoms. Generally, the higher R_0, the harder it is to control the epidemic (13, 20).

Case Definitions. Case definitions include a set of diagnostic (clinical and laboratory) criteria that must be fulfilled to identify a particular disease and are important in determining how decisions regarding limiting spread are made. The case definition may change frequently as the number of cases increases and data become more refined (13). The definitions also vary greatly with the characteristics of the offending pathogen. The epidemiology that influences case definition development is that viruses must: emerge where the general population has little or no immunity; be able to replicate in humans and cause serious harm; and be efficiently transmitted from person to person (21).

Case definitions can often be improved if the emerging case definition includes criteria for the pediatric population, such as: age-specific "severity"; age specificity in diagnostic criteria (neonate, and potential vertical transmission from the mother, child, adolescent); pediatric comorbidities/vulnerabilities (both physical and social); and age-specific protective measures.

A substantive case definition will influence access and availability of services, and will impact each level of contact, families, and schools. It will influence decisions on resources (e.g., equipment and health settings required), and drive just-in-time training and education for health providers, families, and caretakers (13).

Points of contact

Points of contact (POCs) designate specific places where patients make contact with the healthcare community. Four major POCs have been identified: the community, prehospital care, health facilities, and regional level of care and assets (22, 23). All POCs are interdependent, and outcomes, interventions, and triage management are reported as specific to each POC. When these activities occur in a "comprehensive fashion," it minimizes the patient care burden at each subsequent level of intervention (22). If done well, this process reduces overall need to ration care. In pandemics, the initial contact for care might be the citizenry, health hotlines, emergency medical services (EMS), primary care practitioners, or alternate care sites. The Centers for Disease Control and Prevention strongly emphasizes the importance of "layering of community mitigation

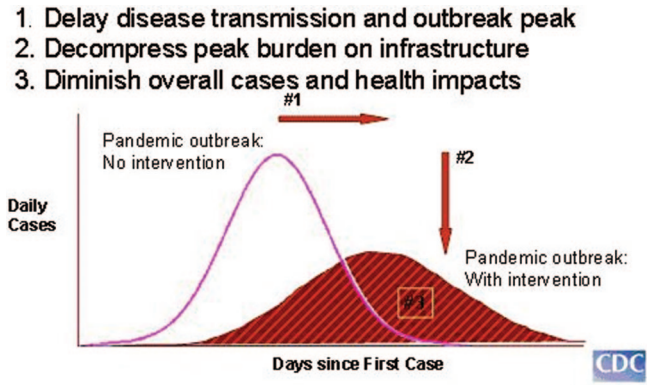

Figure 1. Process of mitigation through community-focused and enhanced reduction of influenza transmission. Based on an original graph developed by the Centers for Disease Control and Prevention, Atlanta, GA, both community mitigation measures and an informed and educated citizenry contribute to the flattening of the curve.

measures," isolating the sick, hand hygiene, respiratory etiquette, and social distancing, as the most effective nonmedical interventions to drive down the transmission of disease and improve the capacity of medical care systems (2, 24). The goal of community mitigation is illustrated in Figure 1.

Citizens. Primary contact and triage begins at the citizen level of response (parent, guardian, family, and institutions, such as schools, nurseries, colleges, and universities). A major error in PHE planning and response is that citizens and the community/faith-based organizations to which many of them belong have not routinely been included in disaster planning. Pandemics have shown that large numbers of noncritical patients can best be managed within a familiar environment (the community) by "capable, nonexpert, caregivers" (25). Reports confirm that the majority of individuals (70%) expect to rely on family members; less than half (48%) expect to rely on their neighbors (26, 27). The large majority of victims from SARS and 2009 Pandemic Influenza A/H1N1 received self or self-assisted care. During future influenza pandemics, the anticipated average of self-care patients in the United States is expected to increase and represent a figure larger than the combined total deaths, patients hospitalized, and those receiving outpatient care (25). Surveillance systems may be overwhelmed and unable to monitor the status of those at home.

Throughout the world, many citizens will undoubtedly turn to the myriad of interlinked social networks that people and families belong to (ethnic, religious, business, and institutional) and rely on for information and meaning in a crisis (13). With the onset of H1N1 in England, over 1.6 million people in the first 3 months used the online cold and flu symptom checker run by the National Health System Direct (28). Hence, it is imperative that pediatric professionals, emergency planners, community/faith-based organizations, businesses, and other partners collaborate to provide public health preparedness and response guidance to community partners for the specific risks (in this case, pediatric care interests) identified in their community risk assessments (Public Health Preparedness Capabilities: National Standards for State and Local Planning, Community Preparedness capability section [14]).

The most powerful applications for self-care are secure e-mail consultation and Internet-based applications, combined with mechanisms to empower self-awareness. Emphasis, however, should be more on delivery of health care, not just the technology. To assist in moving from a hospital-centric to a community-centric focus, the Center for Disaster Medicine and Public Health Preparedness of the American Medical Association is piloting a CitizenReady program that prepares the public to provide basic life-saving information for pandemics and builds physical and mental health resilience in the community. The program has been introduced to the community by local medical and public health groups (I. Subbarao, personal communication). Most importantly, the program assumes informed citizens are a critical and effective component of both mitigation and intervention, encourages and catalyzes citizens to build and strengthen social networks, and ultimately performs as an "intervention strategy" (28). Along with the community mitigation strategies, educated citizens can flatten the curve further by diminishing overall cases and adverse health impacts (Fig. 1).

Call Centers, Hotlines, and Healthlines. Crucial to the process to mitigate surge at hospitals and other facilities is to give people the information they need to decide for themselves what level of care is appropriate. This first line of triage management can be performed by call centers (28). Call centers, hotlines, and healthlines play a key role in delivering high-quality information and support. Pediatric-specific healthlines would be a crucial addition to any anticipated call system.

There are many examples of call centers both nationally and internationally. They functioned in the course of SARS and the 2009 Influenza A/H1N1 Pandemic in educating the populace while contributing to the prevention of disease transmission. During the SARS outbreak in Ontario, Canada, the existing 1-800-telehealth hotline expanded services from an average of 2,000 calls per day to over 20,000 per day. It became an essential health aid and intervention tool and assisted in determining those "probably exposed and requiring referral for care vs. those who were not and needed shelter-in-place and useful information to keep them safe." The Ontario call volume fluctuation reflected directly on emergency department visits for respiratory illness (23).

In the first 10–14 days, many callers were experiencing fear and anger that they or their children might already be exposed. This level of fear is common to "silent disasters" (biological, chemical, radiation). Success was dependent on volunteer nurses and others trained in dealing with health crises and people in highly emotional and anxiety-filled states. Toronto emergency departments were "inundated" with these victims, where they risked exposure as they intermingled with waiting patients who were infectious (13, 30, 31).

The Ontario hotline experience proved successful in integrating real-time syndromic surveillance into the wider system, and as a first line of triage. During the 2009 Influenza A/H1N1 Pandemic, similar hotline systems were deployed in the United Kingdom, China, Mexico, and in New Zealand where a "disease-specific healthline" was deployed as an adjunct to the conventional hotline service (G. McColl, personal communication). Data show that the system was crucial as a

sentinel surveillance site, in educating the public, and in preventing unnecessary health facility visits (32). The U.S. Poison Control system, with 61 centers across the country, is an effective, cost-efficient, and extensive use of this call center concept. Within the United States, Colorado is frequently cited as having a robust system of staffed call centers throughout the state (4). The Denver Health Nurse Line study found that 70% of callers trusted and followed the advice they were given, reducing the impact on the healthcare system (4). These findings are almost identical to those obtained by New Zealand public health authorities. Furthermore, call centers serve as an essential part of overall mass risk-communication and community-care strategies. With an effective call center, the citizenry can ask questions and have their concerns addressed by a trusted entity (4).

Unfortunately, despite these examples, few U.S. communities have refined or organized call systems specifically directed toward pandemics. However, in 2007, the Department of Transportation released "Preparing for Pandemic Influenza: Recommendations for Protocol Development for 9-1-1 Personnel and Public Safety Answering Points" (33). These guidelines are a companion piece to existing EMS guidelines developed in cooperation with federal and nonfederal partners, including the National Association of State EMS (34, 35). In 2009, the Centers for Disease Control and Prevention's Division of Healthcare Quality Promotion released "Coordinating Call Centers for Responding to Pandemic Influenza and other Public Health Emergencies: A Workbook for State and Local Planners" (35). This document deals broadly with coordinating activities among all types of call centers (e.g., 9-1-1, 3-1-1, 2-1-1, nurse advice lines, etc). A recent Institute of Medicine report emphasized that other forms of communications, including Web sites, hospital blogs, Twitter, social, ethnic, and religious networks, interactive voice-recognition technology, and text messaging, may prove to be invaluable during any public health emergency (4).

The Division of Healthcare Quality Promotion has developed community preparedness tools and guidance specific to the pediatric population as a direct result of convened stakeholder meetings with state, local, and federal subject-matter experts. These include the following (all links accessed April 14, 2011):

1) Coordinating pediatric medical care during an influenza pandemic: Hospital workbook (http://emergency.cdc.gov/healthcare/pdf/hospital_workbook.pdf)
2) Guidance from pediatric stakeholders: A coordinated approach to communicating pediatric-related information on pandemic influenza at the community level (http://www.cdc.gov/h1n1flu/guidance/pediatrics_tool.htm)
3) Abbreviated pandemic influenza plan template for primary care provider offices. Guidance from stakeholders (http://www.cdc.gov/h1n1flu/guidance/pdf/abb_pandemic_influenza_plan.pdf)
4) Pandemic influenza pediatric office plan template (http://emergency.cdc.gov/healthcare/pdf/pediatric_office_plan.pdf)

Other documents, although not specific to pediatrics, have relevance and were produced in partnership with other federal agencies and state and local stakeholders (all links accessed April 14, 2011):

1) Hospital pandemic influenza planning checklist (http://www.pandemicflu.gov/professional/hospital/hospitalchecklist.html)
2) Hospital 2009 H1N1 pandemic influenza readiness review checklist (http://www.bt.cdc.gov/healthcare/pdf/hospital_2009h1n1_checklist.pdf)

Prehospital EMS. Primary triage occurs at the prehospital EMS level through emergency medical dispatchers and 9–1-1 call takers, and from EMS personnel at the first POC with the patient. Whereas EMS ambulance services are considered "essential healthcare services" during conventional disasters, internal surveillance studies during the Toronto SARS outbreak showed that EMS capacity diminished rapidly. The system came to a halt when, within 5 days, the majority of the workforce was placed on home or work quarantine (37). Separately, transport of noninfectious patients continued as usual, suggesting that each EMS determine beforehand surge capacity roles and responsibilities that do not compromise the system or needlessly expose personnel or equipment. Telephone triage with pre-established criteria should be used for vehicles other than those designed for medical transport (e.g., buses, rental van) to transport multiple patients on a single run (38). Professional judgment is crucial where demand for EMS services exceeds availability or safety of resources, but protocol-based systems may be more appropriate and afford a better degree of protection from liability.

Community decision makers must be aware that in surge capacity situations, "treat-and-release standard of care protocols" should be considered at the community level when a declared disaster and executive order specify treat and release as an acceptable care option. The use of these protocols assumes that patients are provided the optimum level of care within the availability of resources and never precludes a patient from independently seeking care (39).

Alternate Care Facilities. Traditional venues for health care will most likely be overwhelmed with patients or rendered inoperative, making it necessary to establish alternate care facilities (ACFs), defined as a location for the delivery of medical care that occurs outside the acute hospital setting for patients who would, under normal circumstances, be treated as inpatients, and includes acute, subacute, and chronic care. ACFs routinely encompass all nonhospital-based locations where organized care can be provided at a time of markedly increased need during a natural or man-made crisis. This concept was originally developed and formalized by the U.S. Civil Defense Agency as "packaged disaster hospitals" consisting of modularized, predeployed units for 50, 100, or 200 beds. In 1972, funding for the packaged disaster hospitals concept and the 2500 deployed units was discontinued by Congress, and these units were declared surplus and disposed of over the next decade. In light of pandemic requirements, this concept is being reconsidered (40). Community planners must identify the logistic support necessary for establishing and operating such ACFs, and identify and create protocol-driven patient management objectives based on assumptions about the types of patients that would be managed in such facilities. During pandemics, ACFs may be best suited to function as primary triage sites, providing limited supportive care, offering alternative isolation locations, and serving as recovery clinics to assist in expediting the discharge of patients from hospitals (41). Pediatric-specific ACFs are desirable but may not be practical considering the anticipated scarcity in healthcare workforce resources.

Guidelines for ACFs are that they must first ensure both "access and availability" to primary healthcare, critical to

maintain during any PHE. The guiding principles of PHE planning are (42):

1) In planning, the aim should be to keep the healthcare system functioning and to deliver acceptable quality of care to preserve as many lives as possible.
2) Planning a public health and medical response to a PHE must be comprehensive, community based, and coordinated at the regional level.
3) There must be an adequate legal framework for providing health and medical care in a PHE.
4) The rights of individuals must be protected to the extent possible and reasonable under the circumstances.
5) Clear communication with the public is essential before, during, and after a PHE.

In many resource-poor environments, especially in the developing world, nurses and paramedical professionals are the primary care providers. This same scenario rapidly becomes a reality for developed countries during PHEs. The community and public health authorities must take tally of the available healthcare workforce and determine where they are best placed to ensure the continuity of primary health care. Medical Reserve Corps personnel will be crucial to maintaining this vital resource. If primary care suffers, the consequences will be immediately felt at critical care levels.

To empower a community-based response to public health emergencies, the New England Center for Emergency Preparedness, New Hampshire, in cooperation with state and federal partners, worked to design a new regional-response system (RRS) (43). The RRS is a contingency capability that is activated in response to large-scale disasters and depends on the rapid mobilization and integration of responders and citizen volunteers under a declared state of emergency. The goal of the RRS is to provide a timely and adequate response to an emergency, reducing the levels of death, suffering, and economic loss, while avoiding the chaos that ensues from an overwhelmed system. The onus of response will fall to multiple agencies from multiple jurisdictions using combined local and regional resources. RRS can be utilized for a wide variety of disasters, including those caused by nuclear detonations, pandemic disease outbreaks, chemical and biological attacks, and radiologic or explosive devices, among others. The RRS specifies how communities might rapidly extend their existing response systems - typically designed for limited public health events and incidents, such as fires and accidents - into a new, scalable, flexible response system that can deal with all types of catastrophic events with variable numbers of victims. This community-based, "do-it-yourself" response system provides the framework to bring together local, state, and federal responders, as well as volunteers, from both the affected and neighboring states so that they can quickly and effectively apply their inherent capabilities and expertise. The RRS can provide a contingency capability for thousands to hundreds of thousands of victims. It is designed to quickly utilize all available resources in preplanned ways to keep pace with the emergency and avoid a devastating gap in effective response. Available resources and volunteers are obtained by mobilizing the citizenry through a declared state of emergency by the governor and senior elected officials of substate regions. As the RRS is implemented throughout states, responders and volunteers that come to assist the stricken regions will bring their knowledge of the RRS with them and be better equipped to quickly and effectively assist. Implementation costs are minimized by using small regional planning groups for implementing each RRS element and for conducting learning and table-top exercises. The resulting knowledgeable group of senior elected officials, emergency responders, and volunteers can serve as the core resources for implementing the RRS during an emergency (43).

A key element of the RRS is the modular EMS, which provides contingency medical modules that can be quickly established to accommodate the number of victims. States and substate regions are encouraged to implement modular EMS first, followed by the incremental implementation of the other RRS elements over time to achieve a full capability. This approach will concentrate efforts on the highest priority RRS elements first and allow for the RRS to be implemented in manageable stages. This modular system addresses the need for a grassroots approach, mobilizing local resources in the hours and days after a catastrophic event. The modular EMS operates within the framework of a RRS, which includes five modules for the care of casualties in a large-scale emergency. The **Neighborhood Emergency Help Center** provides offsite triage and initial treatment, or can be staffed as a point of dispensing for prophylaxis medications or vaccine administration. The **Acute Care Center** supports continuity of care when patient numbers exceed hospital capacity by providing a lower level of definitive or supportive care to immediate casualties in structures close to area hospitals, such as schools or auditoriums. The **Community Outreach** module provides the flexibility to care for casualties in their homes, either to quarantine contagious disease outbreaks or when the number of casualties exceeds the capacity of the Acute Care Centers. The **Casualty Transportation System** transfers patients between modular emergency medical system components as well as patient homes, while the **Medical Control Center** coordinates medical direction for modules within their preassigned regional sector (44). The basic structures of this model have been replicated in a number of states (i.e., Vermont, New Hampshire, Maryland, California, and New Mexico). However, in many situations the model provides guidance to communities on how to be creative and cost effective in utilizing community resources and existing "buildings of opportunity" rather than building new structures. Incident-specific resources may come from a variety of federal programs and other resource allocation models (45).

A system-wide approach

Many readers will recognize the importance of existing community organizational tools, such as the Incident Command System (ICS) and the Hospital ICS, that affect a rapid and coordinated response to site-specific disasters. ICS consists of a standard management hierarchy and procedures for managing temporary incident(s) of any size. ICS is a system designed to be used or applied from the time an incident occurs until the requirement for management and operations no longer exists. All ICSs are coordinated by the National Incident Management System (45). The ICS common framework is standard within North America, the United Kingdom, New Zealand, and Australia. Pandemics and other public health emergencies are unique, population-based events that challenge conventional ICS capacity.

A more severe and lethal viral pathogen will make ICUs with their professional staff and highly technical equip-

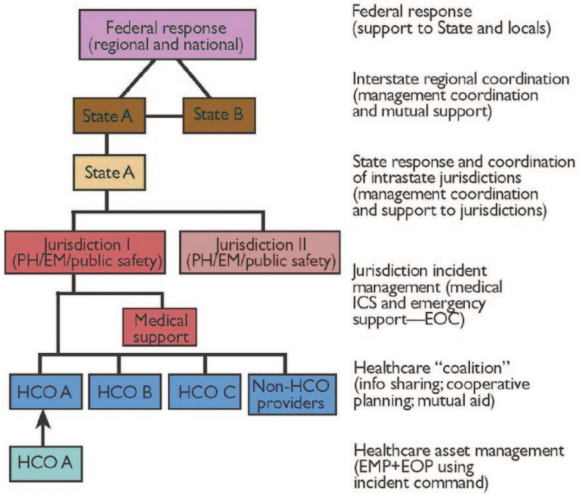

Figure 2. Health and Human Services Medical Surge Capacity and Capability (*MSCC*) framework. *PH*, public health; *EM*, emergency management; *HOC*, healthcare organization; *ICS*, incident command system; *EOC*, emergency operations center; *EMP*, emergency management program; *EOP*, emergency operations plan.

ment a limiting factor. Although there are approximately 1,450 board-certified pediatric intensivists and an estimated 3,500 pediatric ICU beds in the United States (46), the demand for pediatric critical care will rapidly exceed the supply. In fact, emergency departments and hospital wards will be deluged with critically ill patients. Many demanding triage-management and ethical decisions will be made by pediatricians and intensivists alike, working in tandem with other healthcare professionals, a process that is best supported by a healthcare coalition that begins at the community level.

Planning among healthcare institutions for catastrophic health emergencies is still in the early stages (3). However, since the establishment in 2002 of the U.S. Department of Health and Human Services' Hospital Preparedness Program (HPP) (47), the preparedness of individual hospitals throughout the United States to respond to local mass casualty events has significantly improved. Reasons for this are varied, but include the appointment of hospital disaster coordinators, increased recognition among hospital executives of the importance of preparedness, implementation of communication and ICS, National Incident Management System, and development of the Joint Commission Emergency Management Standards (48). The goal of the HPP is to strengthen the ability of hospitals and healthcare systems to prepare for and respond to bioterrorism and other public health emergencies. Since 2002, the program has provided over $2 billion in funding in all 50 states, including Washington, DC, Chicago, New York City, Los Angeles, and various territories (48).

Local and regional healthcare coalitions have also emerged throughout the country since the HPP's implementation, and have created a foundation for U.S. healthcare preparedness (49). A healthcare coalition is a formal collaboration among hospitals, public health agencies, and emergency management authorities in a geographic area; it may also include other types of healthcare entities (e.g., long-term care facilities, specialty hospitals, dialysis centers) (48, 49). Coalition members collaborate before emergencies (e.g., on training, exercises, equipment purchasing, and plan development) and during emergencies (e.g., to share incident information, facilitate situational awareness, maximize patient surge capacity, coordinate resource sharing and allocation, and implement crisis standards of care plans). In addition to local, routine types of mass casualty events, coalitions are essential for the response to catastrophic health emergencies at local, state, regional, and national levels. The Health and Human Services Medical Surge Capacity and Capability framework (Fig. 2) illustrates the role and placement of healthcare coalitions (Tier 2) in the overall federal, regional, state, and local response structure (45, 50). Developed after the terrorist events of 2001, this six-tier framework provides an operational structure for responses to medical and public health emergencies. In addition to the Medical Surge Capacity and Capability guide, the HPP guidance and Joint Commission Emergency Management Standards emphasize the importance of collaboration for healthcare emergencies (51).

Healthcare coalitions have formed throughout the United States, but their capabilities, structure, governance, geographic scope, activity range, and composition vary significantly (47, 49). Healthcare coalitions have also been defined as "individual healthcare assets in a geographic area that work together as a single functional entity to promote their resiliency to hazard impacts and to maximize medical surge capacity and capability through collaborative planning, information sharing, mutual aid, and management coordination" (50). Some coalitions are highly organized (52, 53), with a formal governance structure and link to the jurisdictional emergency operations center (EOC) and Emergency Support Function-8 seat. In Minnesota, for example, a multiagency coordination approach is used for regional planning; a regional medical coordination center links hospitals to a multiagency coordination, which represents emergency management and public health agencies in the region (Fig. 3) (4, 50, 54). Some coalitions represent health entities in a single city or county, while others cross state or jurisdictional lines. Los Angeles County, a recipient of a HPP grant, designated 13 key hospitals as Disaster Resource Centers. Each disaster resource center is assigned eight to ten nearby hospitals to assist in developing plans, preparedness, and resource sharing. To add depth to pediatric disaster care, the Children's Hospital Los Angeles, the only disaster resource center-designated pediatric hospital, has pulled together hospitals with pediatric expertise and strengthened its relationship with the Community Clinics Association of Los Angeles County, a major outpatient pediatric care facility (52).

However, many coalitions are not fully developed or functional, and much of the healthcare system does not participate in them. In addition, existing neighboring healthcare coalitions are typically not linked to one another or to regional networks in a formal way (49). During public health emergencies, this may impede effective and efficient collaboration, communication, and sharing of information and resources among health facilities and emergency management agencies and is why explicit expectations regarding pub-

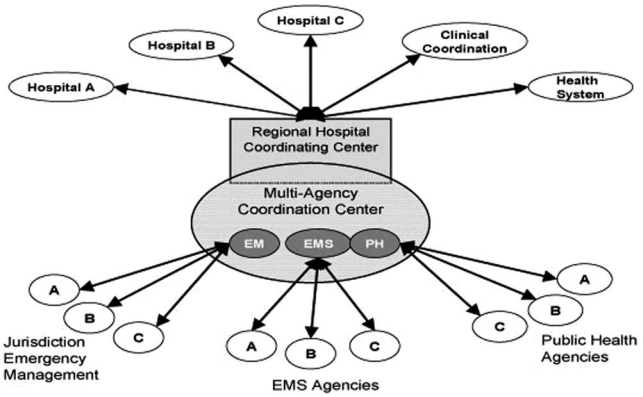

Figure 3. Multiagency coordination center (*MAC*) model. Graphic adapted for and published in Toner E, Waldhorn RE, Franco C, et al: Hospitals rising to the challenge: The first five years of the hospital preparedness program and priorities going forward. Baltimore, MD, Center for Biosecurity of UPMC, prepared for the U.S. Department of Health and Human Services under contract No. HHSO100200700038C, 2009; but graphic is based on Metropolitan Hospital Compact MAC model – Minneapolis/St. Paul, MN, in: Phillips SJ, Knebel A (Eds): Mass Medical Care with Scarce Resources: A Community Planning Guide. Prepared by Health Systems Research, an Altarum company, under contract No. 290-04-0010, Agency for Healthcare Research and Quality Publication No. 07-0001, Rockville, MD, Agency for Healthcare Research and Quality, 2007.

lic health and healthcare coalition activities have been cited in the Public Health Preparedness Capabilities: National Standards for State and Local Planning, under the Medical Surge capability section (14).

Because of the many independent and often competing efforts to address mitigation and preparedness for emergencies, MacIntyre et al (55) suggest the development of a healthcare emergency management profession to integrate these various critical initiatives into the larger community emergency response system.

To ensure effective and consistent decision making and responses, healthcare coalitions should be connected to healthcare EOCs (HEOCs), which are formally linked to jurisdictional EOCs that are part of the community ICS. HEOCs, models of which are present in major urban settings (e.g., Los Angeles, Seattle, Northern Virginia, Houston), provide the form and function crucial to decision making that includes the execution, implementation, and modification of triage protocols, exclusion criteria, and minimal qualifications for survival. HEOCs, as partners with the existing ICS, are supported by public health and infectious disease experts, clinical workforce authorities, epidemiologists, ethicists, psychosocial and behavioral specialists, and legal counsel, at a minimum, to ensure transparent lateral health coordination, cooperation, and communications that would normally not be reflected at the operational level (56). Pediatric representation on clinical care committees, triage teams, state and local level disaster medical advisory teams (e.g., HEOCs), and other decision-making bodies are a necessary first step. HEOCs are a useful supplementary element of the ICS-EOC in any pandemic decision-making process. Whatever guidance emerges must be integrated into a larger, system-wide triage-management scheme that begins at home and ends at whatever regional support system and resources are available and functioning.

A September 2009 Institute of Medicine Letter Report (4) urgently recommends that disaster planners, subject-matter experts, and researchers are needed to address triage, especially for a widespread and prolonged event where all resources will be in use and rationed. Without adequate protocols, the health system will risk needless exposure, loss of functional capacity, and inappropriately triaged and managed patients. Triage-management protocols and algorithms, crucial to guiding resource allocation, have been published in several states that have pediatric centers. These have not been validated or developed with input from the public, nor have they received ethical scrutiny (see the article, "Ethical issues in pediatric emergency mass critical care"). Triage research and protocols have arisen primarily from intensivists and critical care experts who were awakened to those responsibilities during SARS, and then re-challenged during the 2009 Influenza A/H1N1 Pandemic. Triage protocols are best driven by case definitions specifically developed to define management requirements for emerging protocol templates, and to universalize the protocols across all population cohorts. For this to occur, it will be necessary to advocate for enhanced input of pediatric-specific elements into the case definition.

A major challenge facing the pediatric community will be how to transfer critical care to these traditionally noncritical environments, and to ensure quality palliative care and support to those engaged in this essential service. Any solutions must be accompanied by creative operational concepts to increase staffing, transfer of nurses to staff critical care areas, and use of postanesthesia areas and equipment. Kanter (57) has used a quantitative model to demonstrate a reduction in predicted mortality of 47% by using controlled distribution of patients as well as altering standards of care to only essential interventions during a theoretical pediatric critical care situation. Sweney and Poss (45) suggest that a one-quarter reduction is probably more realistic since the widespread nature of a pandemic will limit transfers to other care facilities. Whereas total community response is crucial and encouraging in lessening the impact of hospital settings, the available capacity of ICU/pediatric ICU beds may become the most important pandemic bottleneck in hospital settings. It is where triage management has its greatest implications. However, the premise of this article is that integrated layers of interventions, beginning at the informed-citizen level, provide a community the greatest opportunity to mitigate barriers and optimize best practices at every level of care.

Among the population-based responsibilities facing healthcare providers during a pandemic is the realization that practice as usual will temporarily cease. Providers must look beyond their normal practice settings and become integrated within the community to best determine what measures can delay disease transmission, decompress the peak burden on infrastructure (e.g., pediatric ICUs), and diminish overall cases and health impacts. Pediatricians and pediatric specialists must better understand the system-wide structures that come into play during a pandemic and advocate for the development of, or inclusion in, all aspects of community-level decision making (e.g., citizen education, ACFs, HEOCs, triage protocols). Expanded and

coordinated community efforts will ultimately improve overall quality performance and equity in care, emergency department/ICU/pediatric ICU admissions, occupancy, and outcome indicators.

SUMMARY

The Task Force recommends the following actions by pediatric leadership (those who represent, care for, and advocate for children):

1) Actively promote programs to ensure, before and during a crisis, an informed citizenry and the education of children and families. Promote programs for an informed citizenry and encourage the inclusion of evidence that community and faith-based organizations have both received and learned (knowledge transferred) the recommended preparedness/emergency information as cited in the Public Health Preparedness Capabilities: National Standards for State and Local Planning, particularly as recommended in the Community Preparedness and Medical Surge sections.
2) Advocate for a community level of preparedness that leads to empowered self-awareness, knowledge of the information that best prepares the public to provide basic lifesaving information and self-care, and builds physical and mental health resilience.
3) Advocate for the establishment of permanent national and state level call systems and for disease- and child-specific healthlines as crucial adjuncts during public health emergencies.
4) Advocate for 9–1-1 telephone triage with pre-established criteria and protocols for the proper use and safety of EMS and EMS-sanctioned transportation during pandemics.
5) Work with community planners to identify the logistic support necessary for establishing and operating alternate care facilities, and identify and create protocol-driven patient management objectives based on assumptions about the types of patients that would be managed in such facilities.
6) Advocate for creative operational concepts that provide guidance and protocols sensitive to the needs of the pediatric population. This includes means to optimize critical care opportunities at hospitals and critical care centers, case definition-driven triage-management protocols that provide input from pediatricians and society alike, and representation of pediatric leadership on community level decision-making bodies, such as HEOCs.

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APPENDIX

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