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Chapter 18

Critical Care in Public Health Emergencies

Robert K. Kanter

PEARLS

- All-hazard, as well as incident-specific, planning and preparedness for public health emergencies make a difference in patient outcomes.
- The Hospital Emergency Incident Command System provides a leadership framework within and among organizations responding to an emergency, emphasizing flexibility and scalability, with clear lines of authority and consistent communications.
- Triage sorts patients to match their needs with available resources and evolves according to shifting needs and resources. Failures of triage may subsequently incapacitate an entire hospital.
- In order to provide essential interventions, some resource-intensive interventions, ordinarily considered standard in an intensive care unit, may have to be delayed or forgone in a mass critical care situation, because standard care would reduce the population who could receive life-saving care.
- If a public health emergency overwhelms resources despite mass critical care approaches, rationing might be considered. However, at present the public and professional consensus that would serve as the necessary foundation for rationing to be a feasible option is lacking.

Recent public health emergencies (PHEs) in North America have included the attacks of September 11, 2001, Hurricane Katrina and the subsequent flooding of New Orleans, a major nightclub fire in Rhode Island, wildfires in the West, floods in the Midwest, anthrax exposures, severe acute respiratory syndrome, and an influenza pandemic. Important lessons have been learned. All-hazard as well as incident-specific planning and preparedness make a difference. When carried out, public health preparations (including evacuation, shelter, and infection control) limited major health effects. Unavoidable illnesses and injuries were often minor, requiring outpatient treatment or first aid for the vast majority of patients. Even when critical care was necessary, existing resources were adequate to provide standard intensive care when needed. However, small differences in circumstances in any of these recent emergencies might have resulted in much larger numbers of adults and children admitted to adult or pediatric intensive care units (ICUs). It is easy to imagine disasters that would overwhelm existing ICU resources, unless we prepare to provide critical care in larger PHEs. This chapter is written for members of the pediatric critical care team facing a major PHE.

Basic Concepts

National Response Framework and Incident Command System

Responses to major public health emergencies are organized within a National Response Framework, as outlined by the federal Department of Homeland Security.[1] Emergency responses are always coordinated at the most local jurisdictional level possible, usually at the city or county level. Responses to larger disasters need support from adjacent counties, the state, and sometimes from the federal level. The Hospital Emergency Incident Command System (HEICS)[2] provides a leadership framework within and among organizations responding to an emergency. HEICS emphasizes flexibility for any type of event, scalability to the size of the event, clear lines of authority, and consistent communications. Disaster plans at every hospital incorporate HEICS principles.

Ordinary Surge and Mass Critical Care

Critical care responses to PHEs are scaled according to the size and severity of the emergency (Table 18-1).[3-5] Responses are categorized as (1) ordinary surge, (2) temporary reactive mass critical care, and (3) sustained mass critical care. For a sudden-impact event involving modest (10% to 15%) increases above usual peak hospital capacity at one or more local hospitals, ordinary surge methods would suffice to provide normal standards of critical care to all those who need it. Ordinary critical care surge needs are met by canceling elective admissions, quickly discharging all patients who can safely leave the ICU, mobilizing staff, and adding beds, as feasible. Most hospitals have occasional experience with ordinary critical care surge responses.

Mass critical care approaches would be implemented when a very large PHE threatens to overwhelm critical care resources. It is recommended that mass critical care

Table 18–1 Categories of Public Health Emergencies and Critical Care Responses

No. of Patients	Type of Event and Response	Authority to Implement Response
Modest increase (10%-20%) above usual peak capacity	"Ordinary surge" Usual standards of care	Decision making by usual clinical leaders
Up to three times usual peak capacity	Gradual onset, sustained PHE with adequate preparation, resources meet needs, usual standards of care Sudden-impact PHE, needs exceed resources, temporary "reactive" mass critical care, crisis standards of care Sustained PHE, sudden or gradual onset, needs exceed resources, sustained mass critical care, crisis standards of care	Decision making by usual clinical leaders Decision making by hospital incident commander Decision making by state public health official (varies state by state)[4]
Exceeds three times usual peak capacity	Needs overwhelm resources despite mass critical care, mass critical care, and rationing, crisis and palliative standards of care	Legal basis and liability protections are ambiguous[38]

Data from Devereaux A, Christian MD, Dichter JR, et al: Summary of suggestions from the Task Force for Mass Critical Care, *Chest* 133:1S-66S, 2008.
PHE, Public health emergency.

personnel be able to care for up to three times the usual number of critically ill patients for up to 10 days without outside help. In these circumstances, population-based goals would attempt to maximize numbers of survivors by providing immediate lifesaving interventions to all persons who need them and delaying or forgoing other interventions. Thus standards of mass critical care are not equivalent to normal circumstances and should be considered to be crisis standards of care. Sudden impact events that stress the resources of a community may require the implementation of temporary reactive mass critical care. Experience with a massive surge of critically injured patients after a major fire demonstrated the satisfactory outcomes that are possible as a result of well-organized responses that included elements of the temporary reactive mass critical care approach.[6] A sustained PHE that exceeds resources over a wide area may require the sustained implementation of mass critical care. No historical precedents exist for sustained mass critical care.

In many states existing laws would permit mass critical care to be implemented on a temporary reactive basis under the authority of an individual hospital's incident commander for a sudden impact event that threatens to overwhelm the resources of a hospital. PHE powers are defined on a state-by-state basis.[7] Where laws exist to authorize sustained mass critical care, this authority is generally at the level of a state public health official.

Mass critical care, whether temporary or sustained, should guarantee the following lifesaving interventions that can be performed immediately: (1) mechanical ventilation, (2) fluid resuscitation, (3) vasopressors, (4) antidotes and antibiotics, and (5) analgesia and sedation.

Lifesaving mass critical care interventions would be extended to much larger than usual numbers of patients by the following approaches: (1) Substitution of equivalent available interventions for scarce or unavailable treatments; (2) adapting nearly equivalent available interventions instead of other scarce or unavailable treatments; (3) conservation of resources; and (4) reuse of some single-use items. Such modifications from usual practices would be proportional to the gap between needs and resources and would be implemented in an organized way by each hospital's HEICS.

Pediatric Critical Care Needs and Resources in a Public Health Emergency

If a PHE affected persons of all ages equally, then children aged 0 to 14 years would account for 20% of the patients and children aged 0 to 19 years would account for 28% of the patients.[8] Younger patients may be more vulnerable to infections, dehydration, toxins, and trauma and are less able to protect themselves in a dangerous environment. Thus children may be overrepresented in a patient population during a PHE. Accidents involving a child-specific activity or terrorism intentionally targeting children may result in a patient population predominantly made up of children. Some planning scenarios considered by the Department of Homeland Security exceed the entire national critical care capacity.[3]

Survival rates from high-risk pediatric conditions tend to be better when children receive care at pediatric hospitals.[9-12] The younger the patient, the more age-specific are the treatment requirements. A national survey estimated a pediatric ICU (PICU) peak capacity of 54 beds per million pediatric population.[13] Because normal PICU occupancy exceeds 50%, fewer than 30 vacant PICU beds per million age-specific population are generally available in a region. Because each region may only be served by a single or a few pediatric hospitals, events that disable a pediatric hospital may disproportionately degrade regional pediatric care.

Quantitative models indicate that survival in a PHE would be better if pediatric patient surge is distributed to pediatric beds throughout a region, rather than overloading facilities near the scene of an emergency.[14] Appropriate utilization of pediatric hospitals would be promoted by clear identification of pediatric hospitals.[15,16] Unfortunately, control of patient distribution may be impossible in a PHE.[17] As a result, all hospitals must be prepared to care for some children.[18] Even if pediatric regional resources are used optimally, hospital vacancies to accommodate pediatric surges are empirically much more limited than for adult patients.[19] Whether or not patients are distributed optimally to hospitals, outcomes from a hypothetical large PHE are likely to be better with mass critical care approaches.[14,20]

When the PICU Is Notified of a Sudden-Impact Public Health Emergency

When a sudden-impact PHE is announced, PICU clinical leaders must immediately focus attention on safety of patients and staff. The hospital's HEICS is activated. Normal operations continue until other instructions are received. Staff who are already in the hospital report to their normal assigned work area, notifying their supervisor of their arrival. PICU clinical leaders review the hospital disaster plan, including job action sheets, and discuss pertinent aspects with the staff. When possible, the PICU clinical leaders will be informed about type, number, and arrival time of anticipated patients. However, such information is often unavailable and inaccurate. Scheduled admissions are reviewed for potential cancellation. Patients in the PICU are evaluated for transfer to a lower level of care or discharge.

Based on the initial assessment, ICU leaders need to determine the number of additional patients who could be accommodated with available staff, equipment, supplies, and space to provide normal standards of care. Additional needs for staff, equipment, and supplies should be communicated through appropriate channels in the HEICS. Additional staff is called in when HEICS instructs the staff present to do so. Staff already in the hospital may be reassigned by HEICS. Staff responding from outside should report to a labor pool area for assignment. Areas designated for expansion of services and overflow are prepared when instructed by HEICS.

As information about the event becomes available, PICU physician and nurse leaders provide incident-specific just-in-time teaching to staff when warranted. Just-in-time teaching is especially important when less experienced supplemental providers are assigned to the PICU.

Rapidly accommodating patients from the emergency department (ED) or operating room will be essential in allowing those areas to continue receiving new patients. At all times, clinical leaders must maintain awareness of the environment, operational problems, disaster-related communications, and reactions of staff, patients, and families.

Emergency Department Phase

To provide continuity in patient care, the PICU team must interact closely with the ED. In some cases, PICU staff may be temporarily reassigned to work in the ED. Therefore, the critical care team should be familiar with the ED perspective on disaster responses.

Triage

Triage sorts patients to match their needs with available resources. Triage is an evolving process relative to shifting needs and resources. Prehospital field triage and care is beyond the scope of this chapter, but when it is effective, patients are selected who will benefit from ED care. Some mild patients not requiring ED care may have been overtriaged, and others may arrive at the ED without prehospital assessment. The worried may well constitute a large proportion of patients arriving at an ED. Severely ill or injured patients may arrive later than those with less serious conditions in a sudden impact emergency. Triage categories are assigned in the ED by an experienced clinician whose sole role is to act as triage officer. Elements of the triage process may have to be repeated later according to evolving imbalances of patient needs and resources.

Triage at the ED is performed according to the nature of the PHE. When potential contamination of victims by toxins is involved, initial triage outside the hospital first identifies those needing immediate decontamination to protect the patient, staff, and entire hospital facility. Likewise, when a highly transmissible virulent infection is involved, triage prior to entering the ED identifies and isolates potentially infectious patients at the earliest time to avoid exposing staff and other patients. Failures of triage at the early stages of decontamination and infection control may subsequently incapacitate an entire hospital. When pertinent, the patient's medical record should clearly indicate decontamination procedures done and the patient's infection control status.

Physiologic triage identifies patients needing immediate lifesaving interventions. Physiological triage tools identify patients in five categories: (1) those needing immediate lifesaving interventions; (2) those who need significant intervention that can be delayed; (3) those needing little or no treatment: (4) those who are so severely ill or injured that survival is unlikely despite major interventions; and (5) those who have already died. Care of patients triaged to group 4, those who are so severely ill or injured that survival is unlikely, must deviate most significantly from usual approaches to intensive care. Because of overall demands on the system, scarce resources must be allocated to other patients who are more likely to survive. Group 4 patients are sometimes referred to as "expectant." Expectant patients are defined by current resource constraints as well as physiological observations. Palliative care is always provided to expectant patients. Also see the discussion of rationing at the end of this chapter.

It is beyond the scope of this chapter to advocate one triage tool in preference to others. No single tool is always rapid, completely accurate, appropriate to all ages and disorders, and already familiar to all providers.[21] Staff should be familiar with the physiological triage tool in use locally.

Decontamination

When indicated, decontamination reduces toxic effects for the victim and avoids contamination of staff and the hospital facility. The airway is monitored and maintained during decontamination. Antidotes are given after cleaning the site of administration. Age-specific issues include hypothermia in infants and behavioral limitations. Warm water may prevent hypothermia. Young children need assistance undressing, while some older children resist undressing and require encouragement and some privacy.[22,23]

Infection Control

For a public health emergency involving a highly virulent transmissible infection, infection control must begin outside the ED entrance and continue without interruption in the hospital while the patient is infectious. Infection control practices can be summarized as follows[24]:

1. Standard precautions apply to all patients, regardless of infection status (hand hygiene; use of gloves, gown, mask,

eye protection, depending on the anticipated exposure; and safe injection practices).

2. Contact precautions are used when infection may be spread by direct contact. When a single-patient room is not available, more than 3 feet separation between beds reduces sharing of items between patients. Staff should wear a gown and gloves for contact with the patient or contaminated objects.
3. Droplet precautions prevent transmission of pathogens spread through close respiratory contact. Because these pathogens do not remain infectious over long distances, special air handling is not required. When a single-patient room is not available, more than 3 feet separation with a curtain between beds reduces droplet transmission. Staff should wear a mask for close contact with the patient.
4. Airborne precautions prevent transmission of infections transmissible over long distances when suspended in the air. A negative pressure isolation room reduces airborne transmission. Staff should wear a mask or fit-tested N-95 respirator, depending on disease-specific recommendations. Infection control practices for specific clinical syndromes are detailed in standard references[24] and later in this chapter.

Keeping Families Together, Identifying and Tracking Children, Child Safety

Hospital care of children is more efficient, more effective, and less stressful when the child is accompanied by a family member or familiar caregiver. This need must be balanced against other triage considerations. Unaccompanied children must be properly identified, tracked, and reunited with their families, requiring proper identification of adult caregivers before releasing children to them. Pediatric safe areas in hospitals with appropriate staff supervision are necessary. Sample child identification and tracking documents have been designed.[18]

Intensive Care Unit Phase

For a sudden impact event in which the ED phase lasts a few hours, the ICU phase may last weeks. On admission to the PICU, a "tertiary survey" is performed to detect injuries and disorders that were overlooked in the rapid primary and secondary survey done previously. For standard interventions, template orders and an abbreviated hospital record may extend the capacity of an overloaded workforce. Every effort must be made to guarantee the essential critical care interventions: mechanical ventilation, fluid resuscitation, vasopressors, antibiotics and antidotes, and sedation and analgesia.

In order to provide essential interventions, some resource-intensive interventions that are ordinarily considered standard in an ICU may have to be delayed or forgone in a mass critical care situation, because standard care would reduce the population who could receive lifesaving care. Interventions that may have to be delayed include invasive hemodynamic monitoring, intracranial pressure monitoring, early renal replacement therapy, extracorporeal membrane oxygenation, parenteral nutrition, and frequent recording of fluid balances and vital signs.[3,25] Clinical decision making may have to be based more often on clinical judgment and less often on laboratory and imaging studies.

PICU Operations in a Gradual Onset and Sustained Public Health Emergency

Many of the same considerations pertain in sudden-impact and gradual-onset PHEs. However, a gradual onset allows event-specific preparation. Resources can be augmented and procedures can be developed and practiced. Staff can be trained. Experience in the early phase of the emergency would provide evidence to refine event-specific recommendations. Very rapid publication of such experience has provided rapid evolution of management recommendations in recent PHEs such as the spread of severe acute respiratory syndrome, the H1N1 influenza epidemic, and anthrax exposures.

Space

Patient care space may be adapted by converting single patient spaces to be used by two or three patients. After exhausting PICU space, additional space for mass critical care also may be adapted by using intermediate care units, postanesthesia care units, EDs, procedure suites, or non-ICU hospital rooms. Overflow of critically ill adolescents or young adults may be shared between PICUs and adult ICUs. Overflow of young infants or term newborns may be shared by PICUs and neonatal ICUs. Nonhospital facilities should only be used for mass critical care if hospitals become unusable.

Personnel

Supplemental providers may include physicians, nurse practitioners, physician assistants, nurses, respiratory therapists, pharmacists, and emergency medical technicians who have skills in non-ICU pediatrics or nonpediatric critical care. Rapid credentialing procedures, just-in-time education, and close supervision by experienced PICU clinicians would promote the role of supplemental providers.

Mechanical Ventilation

Mechanical ventilation is detailed in other chapters of this textbook. Most hospitals have only a small supply of standard ventilators and circuits in excess of usual ICU capacity. It may be necessary to consider temporary use of transport and anesthesia ventilators and bilevel positive pressure breathing devices.

Some pediatric hospitals use a single type of ventilator for patients of all sizes, with appropriate circuits and software algorithms. In other hospitals, ventilators usually used for adults that have high compliance circuits and adult algorithms may have to be adapted for use in infants or small children. Some difficulties may be encountered. The inspiratory flow or pressure sensor may not be sensitive to an infant's small inspiratory effort. Thus triggering of inspiration may fail for synchronized intermittent mandatory ventilation, assist control, or pressure support. Likewise, ventilator algorithms to terminate pressure support inspiration may fail in the presence of air leaks around endotracheal tubes. A substantial air leak around an uncuffed endotracheal tube may result in frequent ventilator alarms indicating low pressure or low exhaled tidal volume.

In a volume-controlled mode, adult ventilators may be unable to provide small tidal volumes and inspiratory flow appropriate for a small infant. Pressure-dependent losses of tidal volume in compressible spaces of adult ventilator circuits exaggerate breath-to-breath variation in delivered tidal volume if peak inspiratory pressure varies with patient effort or changing respiratory mechanics. Difficulties in providing small tidal volumes, as well as variation in ventilation due to leaks around uncuffed endotracheal tubes, may be alleviated by using a time-cycled, pressure-limited mode of ventilation.

Supplemental providers need considerable assistance in caring for an infant on a ventilator. Maintaining endotracheal tube patency, stabilization, and proper cuff inflation and evaluating episodes of hypoxia are challenges even for experienced PICU clinicians.

Manual Ventilation

Few hospitals stockpile enough mechanical ventilators to support three times the usual number of ICU patients. The temporary use of manual ventilation with a self inflatable bag may be essential to meet mass critical care goals. Manual ventilation is labor intensive, tiring to operators, and may expose staff to infection risks as a result of close prolonged bedside contact. However, manual ventilation has been used successfully via tracheostomy tubes for days in a polio epidemic,[26] temporarily for hours via endotracheal tubes in a power failure,[27] and during weather emergencies.[28-30] In the patient transport setting, manual ventilation provides similar gas exchange compared with mechanical ventilation.[31-33] Work to manually deliver small tidal volumes to an infant is less than that needed for an adult. Infection risks are negligible except for specific transmissible infections. Self-inflating bags can be used with ambient air or low-flow oxygen. When temporary manual ventilation is provided until mechanical ventilators are available, outcomes are likely to be superior to the outcomes in cases of untreated respiratory failure. Just-in-time training and supervision of supplemental providers may improve their performance in providing appropriate gas exchange and avoiding barotrauma.

Equipment and Supplies

Mass critical care can only be provided if essential equipment and supplies are available on site. Resupply and rental deliveries may be impossible during a PHE. Thus hospitals must balance the benefits of an adequate stockpile against costs of keeping items on site that may never be used.

The Task Force on Mass Critical Care[3] has recommended that a hospital first should target a mass critical care capacity of three times the usual maximum ICU capacity for 10 days. On-site stockpiles per mass critical care treatment space are planned accordingly (summarized in Table 18-2). Warming devices for infants are necessary to avoid cold stress.

While many interventions may be carried out by adapting nearly equivalent equipment and supplies, some adult equipment cannot be adapted to infants and small children. It is essential to stock adequate numbers of resuscitation masks, endotracheal tubes, suction catheters, chest tubes, intravenous catheters, and gastric tubes in pediatric sizes. In a crisis, resuscitation bags intended for adults can be used to manually ventilate infants. However, small resuscitation bags intended for infants cannot provide an adequate tidal volume for an adult or child.

Table 18–2 Equipment and Supply Stockpiles for Mass Critical Care*

Device	Minimum No. per Patient
Manual resuscitator	1.3
Closed circuit suction catheter	1.3†
Endotracheal tubes	1.6†
Yankauer suction device	1.3
Central venous catheters	1.3†
Peripheral venous catheters	6.5†
Intravenous crystalloid solution	20 L
Gastric tubes	1.3†

*Information is provided for selected items. See reference 3 for the full list.
†Numbers refer to a standard adult size. For infants and children, this number must be supplied in a range of pediatric sizes. A larger number of peripheral venous catheters would account for the greater difficulty in achieving venous access in infants.

If cuffed endotracheal tubes are used, it may be possible to cover all pediatric needs with 3.0-, 4.0-, 5.0-, and 6.0-mm cuffed tubes, reducing the need to stock uncuffed tubes in all other sizes. Guidelines for mass critical care ventilators have been provided.[3,34] Because few institutions will have enough ventilators to serve three times the usual number of ICU patients, the option to temporarily provide manual ventilation depends on having adequate numbers of self-inflatable resuscitation bags and endotracheal tubes immediately available.

Medications

In order to extend medication stockpiles in mass critical care, rules should be formulated ahead of time regarding appropriate substitutions, dose and frequency reductions, converting parenteral to enteral administration, restrictive indications, and shelf-life extension.[3] Experience in recent PHEs indicates that very large quantities of analgesics and sedatives are essential.[6,35] Weight-based dosing may be simplified to improve efficiency by specifying a limited number of weight range categories. When time constraints make it difficult to weigh patients, length-based estimates of weight may suffice.[36]

Critical Care in Specific Types of Public Health Emergencies

While all-hazard planning prepares for PICU operations across all types of PHEs, some responses must be event-specific. These responses are detailed extensively in standard references.[24,37] In addition to general critical care support, event-specific hospital responses and treatments are briefly outlined in Table 18-3. For any type of emergency, clinical interventions also will be necessary for illnesses and injuries that are indirectly related or unrelated to the primary event. These illnesses and injuries include patients hospitalized prior to the onset of the PHE.

Table 18–3 Specific Types of Public Health Emergencies and Event-Specific Management

Type of Event	Infrastructure	Decontamination	Infection Control	Disorders/Event-Specific Interventions
Pandemic (influenza, SARS)	Need for negative pressure isolation		Depending on organism, usually a combination of standard, droplet, airborne precautions	Pneumonia, sepsis Antibiotics/antiviral according to organism Antibiotics for bacterial coinfection
Major earthquake	Extensive damage Mass evacuation likely		Standard precautions	Multiple trauma including crush injuries requiring renal replacement therapy
Hurricane	Extensive damage Mass evacuation likely		Standard precautions	Multiple trauma
Nuclear detonation (terrorism)[40]	Extensive damage Mass evacuation likely	Radiation Contamination of body orifices, wounds, skin Treatment of life-threatening injuries is the priority	Standard precautions	Multiple trauma, burns, radiation (bone marrow, immunosuppression, gastrointestinal)
Radioactive dispersal bomb (terrorism)[41]	Local damage and contamination	Radiation Contamination of body orifices, wounds, skin Treatment of life-threatening injuries is the priority	Standard precautions	Multiple trauma, burns, radiation (bone marrow, immunosuppression, gastrointestinal)
Chemical attack Nerve agent (terrorism)		Essential, must be rapid	Standard precautions	Antidotes (atropine, pralidoxime) Anticonvulsants Bronchodilators
Chemical attack Vesicants/blister agent (terrorism)		Essential, must be rapid	Standard precautions	Chemical burns, potential airway injury
Chemical attack Pulmonary agent such as chlorine, phosgene (terrorism)		Move to fresh air Irrigate eyes, mucous membranes, skin	Standard precautions	Airway and pulmonary edema
Biologic attack Anthrax (terrorism)		If known, direct exposure to spores	Standard precautions	Ciprofloxacin Doxycycline
Biologic attack Pneumonic plague (terrorism)			Droplet precautions	Streptomycin Gentamycin
Biologic attack Smallpox (terrorism)			Standard, contact, and airborne precautions	Vaccination

Adapted from Siegel JD, Rhinehart E, Jackson M, et al: *Guideline for isolation precautions: preventing transmission of infectious gents in healthcare settings*: http://www.cdc.gov/ncidod/dhqp/pdf/isolation2007.pdf. Accessed September 10, 2009; and Foltin GL, Schonfeld DJ, Shannon MW, editors: *Pediatric terrorism and disaster preparedness: a resource for pediatricians* (AHRQ publication No. 06-0056-EF), Rockville, MD, 2006, Agency for Healthcare Research and Quality.

Rationing

If a PHE overwhelms resources despite mass critical care approaches, rationing might be considered. Rationing might occur on a first-come first-served basis or by selecting patients most likely to survive as a result of brief lifesaving interventions. Such criteria have been suggested for selecting adults for mass critical care when needs exceed resources.[3,38] Proposed eligibility criteria include absence of severe chronic conditions, predicted mortality not exceeding an arbitrary upper limit, and improving clinical status on periodic reevaluations. At the present time, neither evidence nor consensus of opinion nor law supports the concept of rationing, much less a particular rationing procedure. For PHE rationing to be a feasible option, public and professional consensus is a necessary foundation. Only then could states create a legal basis and liability protections.[39] Better evidence is needed to formulate eligibility criteria and operational plans for PHE rationing.

References are available online at http://www.expertconsult.com.