Commentary
Critical care during epidemics
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Abstract

We recommend several actions that could improve hospitals' abilities to deliver critical care during epidemics involving large numbers of victims. In the absence of careful pre-event planning, demand for critical care services may quickly exceed available intensive care unit (ICU) staff, beds and equipment, leaving the bulk of the infected populace without benefit of potentially life-saving critical care. The toll of death may be inversely proportional to the ability to augment critical care capacity, so critical care health care professionals must take the lead for planning and preparing to care for numbers of seriously ill patients that far exceed available ICU beds.

Introduction

We recommend several actions that could improve hospitals' and communities' abilities to deliver critical care during epidemics and bioterrorist attacks involving large numbers of victims with life-threatening illness. These recommendations are in part the result of deliberations by the multidisciplinary Working Group on Emergency Mass Medical Care, which comprises 33 professionals with expertise in critical care medicine, biosecurity, disaster preparedness, and infection control (Rubinson *et al.*, unpublished data).

In countries with widespread critical care capabilities few, if any, critically ill survivors of traumatic disasters have had to forgo acceptable critical care because of staff or resource shortages [1-7]. In contrast, a naturally occurring disease outbreak or a deliberate epidemic resulting from a covert bioterrorist attack could generate critically ill victims in numbers that greatly exceed a hospital's – or a region's – capacity to deliver traditional critical care [8,9] (Rubinson *et al.*, unpublished data). In the absence of careful pre-event planning, demand for critical care services may quickly exceed available intensive care unit (ICU) staff, beds and equipment, leaving the bulk of the infected populace without the benefit of potentially life-saving critical care.

It is likely that critically ill victims who present to hospitals early in the course of the epidemic – that is, some fraction of the total population who are infected and will become symptomatic – will receive 'traditional' critical care in hospital ICUs. Even with stockpiling of airway equipment, vaso-pressors, and mechanical ventilators (which are important components of the US Centers for Disease Control and Prevention's Strategic National Stockpile [10]), shortages of staff trained in critical care and limited quantities of the vast array of medications and medical equipment commonly used in ICUs make it unlikely that current standards of critical care could be provided for more than just a handful of seriously ill victims. If immediate evacuation of critically ill patients to unaffected hospitals or deployment of critical care trained and equipped medical teams to the affected region are not possible, then we propose that, in such situations, more lives could be saved if a circumscribed set of key critical care interventions were offered to a larger number of patients than if traditional critical care interventions, with all their incumbent human and material resource requirements (i.e. usual standards of critical care), were provided only to a small number of initial victims (Rubinson *et al.*, unpublished data).

Emergency mass critical care requires modification to standards of critical care interventions, staffing, equipment, and triage to provide an acceptable level of care for large numbers of critically ill victims. At a minimum, hospitals should plan to be able to deliver to critically ill patients a basic mode(s) of mechanical ventilation, hemodynamic support, antibiotic or other disease-specific countermeasure therapy, and a small set of prophylactic interventions that are recognized to reduce the serious adverse consequences of critical illness. A detailed rationale for and specifics of these recommendations will be provided in a publication from the Working Group on Emergency Mass Critical Care (Rubinson *et al.*, unpublished data). We encourage the critical care community to review these recommendations, revise and

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ICU = intensive care unit; SARS = severe acute respiratory syndrome.

modify them as deemed necessary, and prepare to implement rational, modified medical protocols in the wake of a significant disease outbreak that overwhelms current capacities to deliver 'traditional' critical care.

Triage

During a large or sustained epidemic, even after modification of critical care standards, available resources will remain taxed. Priority should be given to people most likely to benefit from modified critical care interventions. We encourage the critical care community to develop triage algorithms for clinical conditions that are likely to be seen in most outbreaks (e.g. severe sepsis, acute respiratory distress syndrome) that are based on physiologic parameters, and that are sufficiently discriminating to identify which patients are most likely to benefit from emergency mass critical care. We caution against unvalidated application of triage algorithms originally designed for use in trauma casualties to victims with medical illnesses, because these algorithms may not accurately categorize survival for critically ill medical patients.

A major challenge during an epidemic or other mass casualty emergency will be to determine when, and on what basis, traditional standards of critical care are modified to accommodate emergency conditions, and when modified standards revert to traditional modes of care. Medical professionals, hospital staff, and the affected patient community should actively participate in the development and review of mass care triage standards and protocols. If engagement of care givers and the community is neglected, then mass casualty standards could be misinterpreted and generate distrust or fail to be implemented during a disaster. Medical personnel and community members must understand and agree with the triage plans and be assured that implementation will be fairly applied to all victims. Extensive efforts must be undertaken to guarantee that vulnerable populations will receive equal treatment. Coordination of all affected hospitals to facilitate implementation of similar measures under similar conditions and to reinforce the reality of fairness would be useful, but there is no such 'organizing authority' within the fragmented and mostly private US health care system.

Achieving situational awareness

In natural disasters or terrorist attacks resulting in traumatic injuries, a roughly accurate number of surviving casualties requiring medical care is usually quickly ascertained (within hours). Epidemics differ from other disasters in that they unfold over days or even months and years. The scope and impact of epidemics (whether natural or deliberate) are not immediately apparent. If a bioattack is discovered to have occurred (e.g. if several people within a community present with inhalational anthrax), then it may be impossible to determine quickly whether there has been one attack or several or to ascertain rapidly who else is at risk. It is usually not possible to predict accurately how big an epidemic will become or how fast it can be quenched. This uncertainty has important implications for the medical mass casualty response. How is the decision made to initiate mass casualty protocols or to turn them off? How do hospitals and other health care providers plan for and implement sustained emergency responses unless they know whether an epidemic is waning or expanding?

In an age of bioterrorism and epidemics of emerging infectious diseases, it will be necessary to establish interconnected electronic health information technology systems with the capacity to track patterns of disease in populations in near real time. Rapid learning in the face of an outbreak will be essential. Health information technology systems that enable sharing and near real time analysis of aggregated data could be invaluable for illuminating the course of new or unfamiliar diseases, improving clinical diagnostic accuracy and treatment efficacy, predicting disease outcome, and refining triage protocols. Early in an outbreak a number of treatments may be used, but if they are administered in an uncontrolled manner at the whim of clinicians then determination of their effectiveness may be difficult or impossible. During the severe acute respiratory syndrome (SARS) outbreak, more than 8000 people became ill over several months, and a number of treatment modalities were pursued (e.g. steroids, interferon, and ribaviran), but none within the context of a clinical trials. Were another large SARS outbreak to occur tomorrow, clinicians would have no more clinical trial data on which to base treatment decisions than they had 2 years ago [11]. To help assess treatments during the chaotic atmosphere of an outbreak, technology systems that could capture and aggregate data for large, simple, near real time clinical trials could be invaluable.

Protection of health care workers and disease containment

Contagious pathogens present singular operational challenges that must be anticipated in planning for mass casualty critical care. Hospitals are typically major sources of secondary transmission during outbreaks, and the SARS experience demonstrates that critical care units pose potentially high risks for disease transmission to health care workers and other patients [12]. ICUs in Toronto cared for approximately 80 SARS patients over 4 months, and because of secondary transmission 73 ICU beds (nearly one-third of community and academic medical center ICU beds) were closed for some period during the outbreak [13]. The lesson is that secondary transmission of disease, even with modest numbers of contagious critically ill patients, may force closure of entire ICUs or compel isolation of hospital staff, thus decreasing the critical care capacity just when it is most needed.

All critical care staff should be explicitly and routinely trained in infection control procedures, including how to don and remove personal protective equipment without self-contaminating; what protection is afforded by different levels

of personal protective equipment; and what environmental controls must be employed for given situations. Because illness due to newly emergent pathogens or to bioweapons may present with signs and symptoms that are seen commonly in critically ill patients, and because relevant, point-of-service rapid diagnostic tests are not likely to be available at the outset of a disease outbreak, leaders of critical care units should consider implementing droplet and contact precautions for all critically ill patients with febrile respiratory illnesses, even during non-outbreak conditions.

Conclusion

Historically, critical care has played only a small role in the response to disasters, but the nature of disasters in the era of globalization and catastrophic terrorism is changing. The toll of death, morbidity, and public confidence wreaked by a deliberate or naturally occurring epidemic of infectious disease may be highly dependent on the critical care response. Critical care providers must take the lead in planning and preparing to care for numbers of critically ill patients that far exceed available ICU beds.

Competing interests

The author(s) declare that they have no competing interests.

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