

## Review

# Clinical review: SARS – lessons in disaster management

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## Abstract

Disaster management plans have traditionally been required to manage major traumatic events that create a large number of victims. Infectious diseases, whether they be natural (e.g. SARS [severe acute respiratory syndrome] and influenza) or the result of bioterrorism, have the potential to create a large influx of critically ill into our already strained hospital systems. With proper planning, hospitals, health care workers and our health care systems can be better prepared to deal with such an eventuality. This review explores the Toronto critical care experience of coping in the SARS outbreak disaster. Our health care system and, in particular, our critical care system were unprepared for this event, and as a result the impact that SARS had was worse than it could have been. Nonetheless, we were able to organize a response rapidly during the outbreak. By describing our successes and failures, we hope to help others to learn and avoid the problems we encountered as they develop their own disaster management plans in anticipation of similar future situations.

result of bioterrorism, have the potential to create a large influx of critically ill patients, and disaster management planning should take such eventualities into account. This need was demonstrated in February 2003, when a new illness – SARS (severe acute respiratory syndrome) – spread from the People's Republic of China to 28 countries, resulting in 8096 probable cases with 774 deaths [2]. This review explores the Toronto critical care experience of coping in a disaster outbreak situation. By sharing our experiences and our coping strategies, we hope that others will learn from our successes and avoid the problems we encountered, many of which were a direct result of lack of preparedness. We hope that this review will encourage others to make plans to cope with similar outbreaks in the future, should they occur.

## Introduction

*The Commission recognizes the skill and dedication of so many individuals in the Ontario public health system and those volunteers from Ontario and elsewhere who worked beyond the call of duty ... They faced enormous workloads and pressures in their tireless fight, in a rapidly changing environment, against a deadly mysterious disease. The strength of Ontario's response lay in the work of the people who stepped up and fought SARS. What went right in a system where so much went wrong, is their dedication ...* [1]

Disaster management plans have traditionally been required to manage major traumatic events that create a large number of victims. Infectious diseases, whether they be natural or the

The diagnosis of SARS relies on a high index of clinical suspicion because there is no early, reliable and readily available diagnostic test for the responsible virus (SARS-CoV) [3–6]. Likewise, it is expected that other emerging infectious agents will pose diagnostic challenges. Because of this, as infected individuals present to medical institutions where staff are unprepared, the risk for spread is considerable. An outbreak situation may arise quickly and without much warning, taxing the resources of any health care system and the ability of its personnel to cope. The most fundamental guidance we offer is that you need to have a plan in advance. Since 11 September 2001, the USA and other countries have run exercises to prepare for attacks, including bioterrorism [7–12]. We believe that, based on the way in which SARS crippled our health care system (in particular critical care delivery) and dealt significant blows to our economy, a great deal could be gained from simulating similar events and planning a system wide response to emerging pathogens.

The development of a disaster management plan in the event of emerging diseases poses very unique challenges, and we offer some insights into these below.

### Disaster plan development: leadership and organizational issues

Core to any disaster management plan are leaders with clear responsibilities to coordinate efforts and develop policies to contain the disease; to coordinate resource allocation and manpower; to advise and share information regarding infection control and treatment; to share data and research endeavours; to maintain staff morale; and to provide information to various levels of government, health care institutions, front-line workers and the public [1,13]. The model we propose (Fig. 1) is one of a Central Critical Care Crisis Team, composed of leaders of different subteams of multidisciplinary professionals responsible for domains of crucial importance: clinical management, infection control, education, communication, team morale, manpower and system thinking, data collection, research and, finally, lobbying to ensure resources are available to meet critical care needs. Appointed leaders should have the capacity to gather quickly a team of professionals to help address issues within their domains. Team membership is not a competition or a measure of professional worth. Rather, consideration must be given to who can best fulfill the roles. The role of the Central Critical Care Crisis Team is to coordinate the efforts of the various leaders, to avoid duplication of efforts and, through regular sharing of information, problems and support, to work together to devise creative solutions and anticipate future needs. Concerted efforts to address cross-institutional problems can be addressed in these forums.

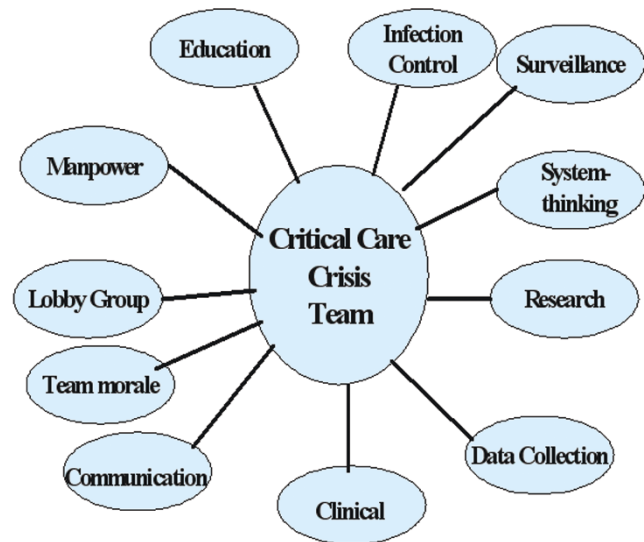
#### Infection control

Any jurisdiction dealing with an outbreak of a new infectious disease must ensure that it has the means to communicate clearly and quickly, as well as receive information, on the following: updated diagnostic criteria; suspected and established epidemiological links; numbers of infected patients as well as those quarantined and at risk; prognosis and treatment issues; current knowledge regarding the most effective means of infection control; and infection control issues specific to different settings [1,13].

Any disaster plan must anticipate needs for infection control equipment [11,14]. The SARS outbreak and the ongoing risk for other emerging infections emphasize the importance of having some basic stock [14], and creating a list of potential suppliers who could rapidly increase their supply is advisable. Requirements may be enormous; one Toronto hospital used 18,000 N95 masks and 14,000 pairs of gloves daily during the SARS outbreak [15].

The importance of infection control measures, and of the development of clear protocols and training cannot be over-emphasized [14]. In Toronto one of the greatest challenges

**Figure 1**



Infectious disease outbreak disaster plan.

that arose was handling the uncertainty of exactly what level of precautions were needed to ensure staff safety. This was an issue that had to be addressed immediately because getting appropriate staff to work required that they felt as protected as possible. Anecdotally, we found in some centres that distrust occasionally emerged between front-line health care workers and leadership. This may have been due to several issues, including the following: there was no clear system-wide communication strategy, and as a result rumours and speculation frequently went unchecked; infection control and other recommendations changed frequently, leading many individuals to question the validity of previous directives; and confusion over whether the responsible virus could be airborne and variable use of airborne versus droplet protection. Of note, subsequent evidence suggests that airborne transmission may in fact be possible [16]. In retrospect, we believe a city-wide, consistent and regular communication strategy (which occurred in some institutions) that acknowledged the fact that leadership was making decisions in the face of uncertainty would have minimized the distrust.

#### Surveillance

Unlike traditional notions of disaster (e.g. bombings), disaster situations from infectious disease outbreaks do not have a clear beginning or end. Disaster planning for these circumstances is unique in that it challenges us to develop practical means to conduct ongoing, widespread surveillance and screening [1,11,13], particularly in light of unclear prodromes and illness presentations and in the absence of diagnostic testing. There is a need to develop a team to track and follow potential epidemiological linkages quickly and to engage in surveillance for *de novo* cases. This team will

potentially have to collaborate across wide geographical regions, engage in open discussion of uncertainty, and develop a surveillance and quarantine strategy that is practical, as comprehensive as possible and does not needlessly isolate individuals and restrict their freedoms. In the face of uncertain diagnostic criteria, it is important to acknowledge that some individuals will be isolated needlessly and some infected asymptomatic individuals will be missed, leading to new cases with the potential to perpetuate the outbreak. It is important that the surveillance team does not seek to assign blame under these circumstances; instead, an analysis of each 'failed' surveillance or error should be undertaken to improve overall knowledge of disease transmission and presentation, and to prevent other infected individuals from falling through the cracks. From the critical care point of view, it is important that there is a feedback loop from these surveillance teams to the critical care leadership, so that that subsequent reliable communication and preparation can be assured.

### **Communication issues**

#### *Front-line workers*

Any information regarding the transmission of disease to staff, an analysis of how such spread may have occurred and advice regarding future preventative measures should be made available to everyone. In the present era of global travel, it is increasingly unlikely that one centre or one country will be dealing with new emerging diseases in isolation. Disaster planners are challenged to develop a global perspective, including accurate communication of events as they unfold in distant jurisdictions. As a result, links to colleagues locally, nationally and internationally are vital in a disaster situation.

Websites providing the most up-to-date information regarding the outbreak, modes of transmission, clinical presentation and required infection control measures can ensure speedy communication to large numbers of people. In addition, such websites can be used to teach how to don protective gear, discuss and outline treatment strategies, teach how to respond to unique crisis situations (e.g. cardiac arrests while maintaining infection control measures), and serve as a way to train treatment teams at different hospital sites. Indeed, internet-based technology proved invaluable during the SARS outbreak in Toronto by allowing our experiences and our newly, on occasion painfully, gained knowledge to be shared with other affected centres and countries. Colleagues in unaffected countries were warned and prepared (for example, see SARS resources [17]). The establishment of such systems for communicating and sharing information, resources, data and research endeavours is one of the clear successes in the management of SARS. Efforts to establish such links should be made in all future outbreak situations [18].

#### *Patients and families*

Those affected by SARS were scared. We were unable to provide them with much information; they were isolated and prognosis was very uncertain. Affected patients must be kept

as informed as possible. Family members who had had any contact with the patient were placed in strict quarantine, and as a result they were not allowed to visit, even if a loved one was dying. Any disaster management plan must anticipate the isolation and need for informational, psychological and emotional support for those immediately affected, including loved ones. The Toronto experience suggests that there is a need to develop more effective means to convey information on quarantine and infection control and to provide support [19].

#### *Media and public*

In Toronto, the SARS outbreak received unprecedented media attention. Daily headlines generated widespread fear and panic. Efforts to decrease sensationalism, to portray an honest picture, and to elicit the help and understanding of the public were lessons that can be learned for any disaster management plan [20,21]. Assigning one team of professionals, as outlined in Fig. 1, to inform and update the media would ensure that consistent information is provided, and would avoid the confusion, fear, anxiety and even chaos that can potentially arise (frequently resulting from inaccurate information) if left unchecked.

### **Education**

Educating teams on how to treat infected individuals, mount surveillance for others, observe infection control measures, respond to emergency situations, collect data and conduct research, and support each other is vital. The education team would be responsible for the creation of educational packages that could be disseminated across many institutions. In addition, mobile educational teams can be deployed to individual institutions to meet specific needs. By developing and ensuring consistent standards of infection control across institutions, these teams not only will help to decrease the transmission of disease and avoid prolongation of the outbreak, but also will serve to support staff morale by helping them to develop means to overcome any environmental barriers to infection control, sharing experiences and emphasizing the fact that everyone faces similar challenges and is working together.

When the outbreak is controlled, educational efforts are not over. The team responsible for education must also be prepared to analyze its performance and devise ways to improve. In addition, ongoing training exercises, potentially using simulators and mock outbreak/disaster exercises, must be instituted to ensure that knowledge gained is not lost and that front-line workers are prepared for the next time, because this next time may arise with little or no warning. Finally, the SARS outbreak also helped us to identify another educational need by our intensive care unit (ICU) fellowship trainees – the need to provide them with practical hands-on experience in leadership.

### **Team morale/manpower**

During the SARS outbreak health care providers felt isolated [22,23]. Many front-line workers curtailed interactions with

their families and friends for fear of transmitting the disease [22]. Others were treated as pariahs. Front-line workers were required to manage a level of critical illness that they might not usually have managed [23,24]. Infection control measures were burdensome and difficult to bear. Despair and depression became common [23,24].

Regular communication via teleconferences and e-mails became the new means to provide support. These provided a forum to dispel rumours, clarify media reports, synthesize the barrage of government directives, and support those feeling isolated as we sought to work in extremely difficult and demanding conditions, such as seeing our colleagues placed in quarantine after exposure, some of them falling ill, becoming critically ill and even succumbing to SARS.

Staff morale was addressed in some institutions by encouraging and commending health care workers, and congratulating them, whether for their efforts to treat patients, collect data, communicate with other centres and share information, improve infection control measures or teach others, or for simply surviving the day and/or night. Some hospitals instituted regular group support meetings and debriefing with the help of psychiatric or emergency response crisis teams.

The most effective way to provide support is not currently known. Particular attention to devising ways to decrease isolation and the emotional and psychological burdens should be an integral part of any disaster management plan. During an outbreak, providing support does not necessarily require a complicated plan. Providing meals or refreshments to staff working in cumbersome, hot and heavy protective gear, and providing safe areas to relax in are simple, easy and well appreciated means to convey support. The presence of leaders who are prepared to risk their own health alongside front-line staff, who listen to staff concerns and address them to the best of their ability, and who discuss and/or reiterate management plans is another straightforward means to provide much needed support and a boost to staff morale. It is important that leadership demonstrate willingness to participate in the front-line environment. Finally, consideration of the need for management of post-traumatic stress disorder, in consultation with psychiatric colleagues, is prudent, and such investment is likely to prevent some of the long-term disability we have seen.

Any future similar situations will also pose challenges to professionalism. As seen with SARS [22] and the emergence of HIV [25–27], most health care providers never anticipated being in a situation that put their personal safety, health and potentially their lives and those of their families on the line. Questions arose regarding whether there is a duty to care and how much personal risk should be expected [22]. Some refused to care for SARS patients, and some refused to even enter wards containing SARS patients [22]. Others

demanded ‘danger pay’ and compensation for illness and quarantine. Understandably, some worried about the extent of their disability and life insurance coverage. These views raised further challenges, fracturing the front-line teams who found themselves asking what, if anything, made their colleagues’ lives more ‘valuable’ than their own. Issues of duty to care and of balancing personal risk and professional obligations remain for a large part unanswered. Further research and debate is required. Disaster planning must, however, consider whether such issues are likely to arise and include potential strategies to deal with them. Consideration should be given to developing means to decrease the anxiety regarding transmission of illness to family members; these could include child care and arranging the provision of alternate living quarters for staff, among others.

#### **Intensive care unit resource management: manpower and beds**

During the SARS outbreak, the supply of critical care beds became a significant concern because of the need to manage a surge of unanticipated critically ill patients. This was a big problem because our occupancy rates were already unacceptably high. This supply issue will become a crucial concern in any future outbreak or disaster situation. In addition to our problem with bed availability, the human resources component further exacerbated the problem; the staff numbers were reduced by fear of contracting the disease, quarantine and illness. When SARS transmission occurred in ICUs, entire units were quarantined for 12–14 days. Of tertiary care university medical/surgical ICU beds and community ICU beds in Toronto, 38% and 33%, respectively, were closed at some point [28]. Maintaining provision of ICU services to non-SARS patients became an important consideration as the outbreak progressed. In anticipation of future outbreaks, plans to organize critical care resources to meet the needs of all critically ill patients should be developed. For example, critical care beds can be rapidly augmented by other areas of the hospital that are adequately equipped (e.g. recovery rooms, operating rooms, emergency rooms, etc.).

Institutions do need to develop their own individual plans based on their available resources, and must share the models/strategies that they institute so that others can learn and potentially adapt these plans to their own centres. However, one of the most important roles played by the Central Critical Care Crisis Team is to help create more ICU resources, rapidly. The scope of future outbreaks or disasters will always be uncertain, but, potentially, critical care providers will need to be able to care for many, many more patients very quickly. Because most ICUs currently function at very high occupancy rates, absorbing such additional numbers is unimaginable. Meeting these needs clearly requires us to move from institution-based to system-based thinking. In addition, critical care providers must be prepared to make tough decisions regarding triage and standards of care. Critical care providers should pre-develop engineering

plans to isolate wards, rather than those that were developed by necessity on-the-fly in Toronto.

### From silos to system-based thinking

The creation of such a system-based disaster management plan is not an easy task. Sharing information and learning from collective experience requires unprecedented collaboration and open communication between all levels of government, health care organizations and front-line workers. There is no room for political barriers, institution-based thinking (as opposed to system-wide thinking), bickering over responsibilities, or consideration of personal professional gain [1,13]. System-wide thinking may challenge even the most seasoned of critical care providers because the scope of current barriers, the number of people involved and the effort needed to get them to collaborate on such a broad scale is not something that they will necessarily have experienced or tried to tackle in the past.

These systems versus institutional issues are common in any health care system; in Toronto they worsened the impact of SARS, and in the early days of the outbreak they diminished much needed communication and collaboration [1,13]. We also observed that in many hospitals there was duplication of some efforts, wasting precious resources [1,13] at a time when, after many years of cutbacks and strain, we did not have resources to waste. Events such as SARS challenge all of us to review the organizational structure of our health care systems and correct potential problems that may arise in similar situations [1,13]. Consideration should be given to designating specific hospitals as main centres for screening suspected cases and treating those affected; identifying hospitals to meet general and those to meet more specialized care needs of other critically ill patients; devising means to increase critical care resources within the affected region; and identifying institutions to decant certain patients to (e.g. alternate level of care patients) and to provide for specific ongoing needs of the population (e.g. cardiac services).

Although the designation of outbreak hospitals does place a greater toll on front-line workers in these institutions, those health care providers caring for greater numbers of SARS patients in Toronto actually experienced less anxiety in the form of post-traumatic stress disorder symptomatology [29]. Such measures may also result in faster disease containment (by decreasing breaches in infection control) and better patient care as the teams become more familiar with the disease. Unlike the Toronto experience, in which SARS hospitals were designated late in the outbreak, SARS hospitals in other countries experienced little to no transmission to staff [30]. In Toronto, entire ICUs were quarantined as a result of transmission of SARS to staff [28]. Subsequently, provision of critical care to both SARS patients and all other critically ill patients was jeopardized. Although designation of outbreak hospitals seems a simple solution, it is not as easy as it appears. For example, finding staff willing to

work in such a setting is a challenge. In addition, such a plan does not preclude other hospitals from knowing how to deal with the illness because, for the most part, the diagnosis is not clear for several days and originating hospitals will need to be prepared to manage patients until that point. Furthermore, designated hospitals will need access to other medical services as affected individuals develop other complications. Finally, the act of transporting such contagious individuals is not without considerable risk, and hence transportation requires careful planning. We recommend that regions develop and, importantly, test plans for working as a system during a disaster like this.

### Lobbying

Intensivists played a vital role during the SARS outbreak. The ICU saw the greatest mortality and had to deal with high-risk situations that increased the risk for contracting the disease [14,28,30]. Infection control and issues specific to ICU care and resource allocation meant that having a voice was vital. Such lobbying for ICU resources must be started now. The SARS outbreak has taught us that we can no longer accept, without comment or objection, the present need to cope and function, day in and day out, in a situation of inadequate critical care resources and manpower. The importance of having all levels of government understand what critical care is, what our needs are, and the help we require to serve our patients now and in the future is perhaps the most valuable lesson of all that we offer to our readers – one that we learned the hard way from surviving the SARS outbreak.

### Conclusion

SARS emphasized the need for disaster management plans to include new emerging infectious diseases. As our knowledge of SARS-CoV grows, our strategies for diagnosis, treatment and containment will improve. New infectious diseases and/or possibly bioterrorism will take the place of SARS-CoV and will similarly challenge us. Training our staff and our future ICU trainees for such eventualities, through the use of simulators and mock disaster codes, has become necessary to build on our successes and learn from our past to avoid the problems we encountered during SARS.

### Competing interests

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

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