Evolution of the Hospital Capacity for SARS in Taipei

Tzong-Luen Wang, MD, PhD; Kuo-Chih Chen, MD; I-Yin Lin, MD;
Chien-Chih Chen, MD; Chun-Chieh Chao, MD; Hang Chang, MD, PhD

Abstract

To assess the medical severity index for a disaster, there are three capacities that should be considered. They were medical rescue capacity (MRC), medical transport capacity (MTC) and hospital response capacity (HRC). We retrospectively analyzed the capacities of Taipei City and tried to find the limiting factor for severe acute respiratory syndrome (SARS) before and after the endemics this year. On April 9 2003, the available isolation beds were totally 128, whereas total number of beds enrolled in Emergency Response Hospitals in Taipei City was 20,160. In other words, the percentage of isolation beds was only 0.63%. Ideal HRC for those hospitals should be 630 patients per hour that was significantly higher than the real needs (0.38 cases per hour). Because of the cumulative reported cases being 518 in northern area and the consideration of case accumulation from April 10 to June 10, however, the hospitals could work within their capacities in only 14 days. The total isolation facilities in Taipei cities were 630 beds (3.1%; $P<0.01$ v 0.63%) in July 2003 and accounted for 70 working days ($P<0.01$ v 14 days). In conclusion, the total number of the isolation facilities instead of the HRC was the critical factor that limited the SARS management. *(Ann Disaster Med. 2003;2:26-31)*

Key words: SARS; Isolation Facilities; HRC; Emergency Medicine

Introduction

Severe acute respiratory syndrome (SARS) is a disease manifested by atypical pneumonia and rapid progression to respiratory distress.[1-4] It has been proven to be caused by the coronavirus.[5-7] In the viewpoint of disaster medicine, the preparedness for such an infectious disease should be similar to that for bioterrorism. According to Advanced Health in America,[10] hospitals have multiple missions: patient care, clinical education, clinical research, and community service. Two of them, or patient care and community service, combine together when a community prepares for an emergency or disaster.

The hospitals are responsible for patient care along the disaster, whereas their community service begins at the usual time as they develop and implement their disaster plans. The hospitals should therein be engaged in the development of emergency response systems, staff training, and logistics in order to continue caring

From: Department of Emergency Medicine, Shin-Kong Wu Ho-Su Memorial Hospital, Taipei, Taiwan
Address for reprints: Dr. Tzong-Luen Wang, Department of Emergency Medicine, Shin-Kong Wu Ho-Su Memorial Hospital, 95 Wen-Chang Road, Taipei, Taiwan
Received: July 2 2003. Accepted: July 8 2003.
Tel: 886-2-28389425 FAX: 886-2-28353547 E-mail: M002183@ms.skh.org.tw

for their patients and their own staffs under sufficient supply of equipment and medicine.

No matter the internal disasters or external disasters, the hospitals were expected to have their reasonable estimation of their own capacities of management. The capacities depend upon many factors such as personnel, incident command system, logistics, transportation and communication. Although an all-hazard model provides a well-established response style, the capacities for different disasters may still be different and need to be carefully estimated.

However, there have never been any events of bioterrorism or devastating infectious diseases such as SARS in recent decades. Some planning of preparedness for the above events may become a so-called "paper plan syndrome". We therein retrospectively analyzed the capacity and actual demand of isolated facilities and hospital response capacity (HRC) in Taipei City in order to find the limiting step in the management of the endemics.

Methods

Definition

When the capacity of a region's medical resources are exceeded during an incident then it can be termed a disaster. Categories of casualties included: (1) dead and dead-on-arrival; (2) life threatening cases needing immediate attention; (3) non life-threatening cases requiring hospital treatment; (4) casualties not necessarily requiring hospitalization. The following three categories (or capacity) should be considered. The first was severity of an incident in terms of injury (S). It implied that if many seriously wounded casualties are expected (categories 2 and 3) then the S value is 1.5. If only many slightly injured persons are expected then the S value is 0.5. Intermediate situations such as traffic accidents have an S value of 1.0. Hospital treatment capacity (HRC) was defined to be the hourly treatment capacity is the number of category 2 and 3 casualties that can be treated according to normal medical standards in one hour. For general hospitals this is estimated as 3% of the total number of beds. Since most hospitals can work efficiently for up to 8 hours the total capacity is taken to be 8 times the hourly treatment capacity. Medical rescue capacity (MRC) meant that the rescue capacity depends on the number of trained medical professionals available at the disaster site. A trauma team with surgeon anesthesiologist nursing support and supplies can handle about 10 category 2 and 3 patients per hour. Under difficult conditions the capacity to deliver care is reduced. The rescue capacity should equal the hourly hospital treatment capacity of the region. Medical transport capacity (MTC) meant that the transport capacity depends on the number of ambulances with drivers and it is affected by the ease of evacuation the distribution plan and the size of the event. A typical ambulance crew can be expected to handle 2 patients per hour but this may be reduced by poor conditions. The transport capacity should try to match the hourly hospital treatment capacity of the region. Medical severity index (MSI) was defined to be the result of casualty load times severity of incident divided by capacity of the region.

According to the definition of the World Health Organization (WHO),[11] a suspected case is the person with a documented fever (body temperature > 38¢J), lower respiratory symptoms, and contact with index patients. A suspected case that had chest radiographic find-

ings of pneumonia, acute respiratory distress syndrome, or unexplained respiratory disease resulting in death with autopsy results demonstrating the pathology comparable with SARS is considered a probable case.

Data enrollment

We collected the data of all emergency response hospitals in Taipei provided by Department of Health, Taipei City Government. There were 12 administrative areas and overall 53 emergency response hospitals which accounted for 20,160 beds in Taipei City in 2002. Of the hospitals, seven were the tertiary care medical centers and the remaining 46 secondary hospitals. The isolation facilities of these hospitals and the average duration of hospitalization for the victims of probable SARS were measured.

Statistical anaylsis

The categorical data were inputted in Microsoft Excel 2000 for descriptive statistics and further qualitative analysis. These results were analyzed using the chi-squared test. ANOVA with a Newman-Keuls post hoc test was used to determine whether any significant differences existed among continuous data. A $P<0.05$ was considered to be statistically significant.

Results

HRC before SARS

According to the data obtained from Taipei City Government, the isolation beds available were totally 128 in April 9 2003. The total number of beds enrolled in Response Hospitals in Taipei City was 20,160. In other words, the percentage of isolation beds was only 0.63%. Ideal HRC for those hospitals should be 630 patients per hour which was significantly higher than the real needs (0.38 cases per hour). Because of the cumulative reported cases being 518 in northern area and the consideration of case accumulation from April 10 to June 10, however, the hospitals could work within their capacities in only 14 days.

If only seven medical centers were enrolled as analysis, the total number of beds was 9,792, and that of the isolated beds 70. In other words, the percentage of isolation beds was only 0.71% (P=NS v 0.63% for total hospitals). However, under the policy of gathering the patients into medical centers, the 7 medical centers had to take care of at least 70% of the cases of probable SARS and could tolerate only 10 days.

The total isolation facilities in Taipei cities were 630 beds in July 2003. In other words, the percentage of isolation beds was 3.1% that was significantly higher than the value before April 10 2003 ($P<0.01$). Accordingly, the hospitals could work within their capacities in 70 days ($P<0.01$ v 14 days in April 10 2003) if the similar event occurred.

In the mean time, the isolated beds in 7 medical centers were 238. In other words, the percentage of isolation beds was 2.4% (P=NS v 3.1% for total hospitals) but significantly higher than the value in April 10 2003 ($P<0.01$). However, the insignificantly lower percentage found in these medical centers accounted for the policy that the cases with highly transmittable disease should be deposited to so-called isolation hospitals.

Discussion

According to Advanced Health in America,[10] mass casualty incidents that result from infec-

tious causes are different from all other types of disasters for many reasons, including: (1) the onset of the incident may remain unknown for several days before symptoms appear; (2) even when symptoms appear, they may be distributed throughout the community's health system and not be recognized immediately by any clinicians; (3) the initial symptoms may be similar to those of the flu or the common cold so that the health system will have to care for both those infected and the "worried well" (such as the suspected cases of SARS but finally tested negative); (4) After being undetected for days, some infectious agents may already transmitted in their "second wave" before the first wave is identified; (5) public confidence in government officials and health care authorities may be striked by the initial uncertainty about the cause of and treatment for the outbreak; (6) health care authorities want to restrict those infected to a limited number of hospitals but the public may seek care from a wide range of institutions; and (7) health care workers may be reluctant to place themselves or family members at increased risk of work.

Mass casualty incidents always overwhelm the resources of health institutions, and require a sustained demand for health services rather than the other short-acting smaller scale disasters. This situation imposes many new considerations and issues to preparedness planning for hospitals. Because of their emergency services all the time, hospitals will be considered by the public as a vital resource for diagnosis, treatment, and follow-up for both physical and psychological care. The question is whether the SARS endemics are one of mass casualties. Because of its contiguous nature, the disease control of SARS needed more personnel than a usual mass casualty did. It should be logistic that the endemics be considered as a long-standing mass casualty. Furthermore, the long-standing character of the event caused the limiting step to be the total capacity (or the number of isolated facilities) instead of three categories of MSI, as our report demonstrated.

The WHO guidelines on diagnosing SARS emphasize respiratory tract symptoms such as cough, shortness of breath, and breathing difficulty.[11] However, these clinical symptoms in the WHO case definitions do not feature strongly in the early stages of the illness, when patients are highly infectious but before they are hospitalized. In screening patients for SARS systemic symptoms such as fever, chills, malaise, myalgia, and rigors may be better discriminators than the symptoms listed in the WHO guidelines, which were based on study of patients who were already in hospital. The low sensitivity of the WHO criteria[12] made it a tendency to enroll at least 4 times of the people admitted to the isolated facilities. In Taiwan, the ratio of confirmed cases and reported cases were also similar. In other words, the reserve for isolation should be at least 4 times of the actual need. Most of the studies revealed that SARS is a disease transmitted by droplets or close contact. If some infectious disease that was highly infectious and transmitted by airborne route, the situation will be more difficult.

In conclusion, the total number of the isolation facilities instead of the HRC was the critical factor that limited the SARS management. Adequate reserve for isolation may be the most important step for preparedness of bioterrorism or other infectious disease such as SARS.

References

1. Severe acute respiratory syndrome (SARS). Wkly Epidemiol Rec. 2003;78: 81-3
2. Acute respiratory syndrome China, Hong Kong Special Administrative Region of China, and Viet Nam. Wkly Epidemiol Rec. 2003;78:73-4
3. Tsang KW, Ho PL, Ooi GC, et al. A cluster of cases of severe respiratory syndrome in Hong Kong. N Engl J Med. 2003;348:1977-85
4. Lee N, Hui D, Wu A, et al. A major outbreak of severe acute respiratory syndrome in Hong Kong. N Engl J Med. 2003;348:1986-94
5. Poutanen SM, Low DE, Henry B, et al. Identification of severe acute respiratory syndrome in Canada. N Engl J Med. 2003;348:1995-2005
6. Update: outbreak of severe acute respiratory syndrome: worldwide, 2003. MMWR Morb Mortal Wkly Rep. 2003; 52:269-72
7. Peiris J, Lai S, Poon L, et al. Coronavirus as a possible cause of severe acute respiratory syndrome. Lancet. 2003;361: 1319-25
8. Ksiazek T, Erdman D, Goldsmith CS, et al. A novel coronavirus associated with severe acute respiratory syndrome. N Engl J Med. 2003;348:1953-66
9. Drosten C, Gunther S, Preiser W, et al. Identification of a novel coronavirus in patients with severe acute respiratory syndrome. N Engl J Med. 2003;348: 1967-76
10. American Hospital Association. Hospital preparedness for mass casualty. Final report. August 2002
11. World Health Organization. Case definitions for surveillance of severe acute respiratory syndrome (SARS). Available at http://www.who.int/csr/sars/casedefinition/en/. Accessed May 12, 2003
12. Rainer TH, Cameron P, Smith DV, et al. Evaluation of WHO criteria for identifying patients with severe acute respiratory syndrome out of hospital: prospective observational study. BMJ 2003;326:1354-8