Impact of Severe Acute Respiratory Syndrome (SARS) Outbreaks on the Use of Emergency Department Medical Resources

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Background: The impact of the severe acute respiratory syndrome (SARS) outbreak in 2003 on the emergency department (ED) medical needs of adult patients has not been elucidated. The purpose of this study was to investigate the demographic and clinical characteristics of ED adult patients before, during and after the SARS epidemic in a SARS-dedicated hospital.

Methods: A retrospective, ED chart review was conducted, and demographic data were obtained from a computer database, for a total of 17,586 patients. Patient information, including age, gender, mode of arrival, triage category, time of visit, main diagnosis, use of ED services, and status after the ED visit, were collected and compared for pre-, early-, peak-, late-, and post-SARS epidemic stages.

Results: Demographic data demonstrated a significant decrease in patient attendances per day, with a mean reduction of 92.5 ± 8.3 patients (43.7 ± 3.9% reduction in rate; $p < 0.01$) during peak- versus pre-epidemic stages, but revealed no differences in patient age and gender. The numbers of patients with ambulance transport, inter-hospital referral, and critical illnesses, including DOA, categorized as triage 1, or admitted to a ward or intensive care unit after the ED visit, were not influenced by the SARS epidemic. The number of patients with upper airway infections and suicide attempts from drug overdoses increased, but not statistically significantly. The number of patients with other diagnoses decreased progressively from early- to peak-epidemic stages, but returned to their earlier levels at the post-epidemic stage. Statistically significant decreases ($p < 0.05$) were noted in mean attendance at peak-versus pre- and early-epidemic stages for patients with cardiovascular disease, inflammatory or functional bowel disease, endocrine disease, dizziness or vertigo, or trauma.

Conclusion: The SARS outbreak did not eliminate the need of critically ill patients for advanced medical support. However, besides an overall decrease in patient numbers, the SARS epidemic markedly altered demographic information, clinical characteristics, and the use of medical services by adult patients in the ED of a SARS-dedicated hospital. [*J Chin Med Assoc* 2005;68(6):254–259]

Key Words: demography, diagnosis, emergency department, severe acute respiratory syndrome

Introduction

The coronavirus assumed to be transmitted via respiratory droplets[1] and direct contact,[2] and to cause severe acute respiratory syndrome (SARS), can lead to nosocomial infection in health workers, including health care assistants, nurses, and physicians.[3] Indeed, From April 22 to May 1, 2003, the number of probable SARS cases tripled among hospital visitors, hospitalized patients, and health care workers without adequate

protection against SARS acquisition.[4] The mass media kept reminding people that hospitals could be a setting of high SARS infectivity. Patients would, therefore, have made every effort to avoid the emergency department (ED) unless they were in acute or special clinical need. Patients who had to visit an ED in a SARS-dedicated hospital were invariably stressed and fearful about acquiring the infection.

Previous reports[5,6] demonstrated a substantial reduction in total ED attendances at the peak of the SARS epidemic. However, these studies did not assess changes in clinical characteristics and disease patterns among ED attendees. Understanding the potential for such changes will optimize the functioning of emergency physicians, trauma surgeons, sub-specialists and hospital coordinators if faced with a future, un-expected outbreak of SARS or other highly infectious disease. The purpose of this study was to investigate the impact of the SARS epidemic on the use of medical resources in ED adult patients in a SARS-dedicated medical center.

Methods

SARS epidemiology

The Taipei Veterans General Hospital is a tertiary re-ferral and teaching medical center, with 2,700 beds, in northern Taiwan. Assigned as one of the 15 SARS-dedicated hospitals, the institution had established the mechanisms necessary to identify potential SARS patients in the ED, and had equipped 70 negative-pressure isolation beds for the admission of SARS patients during the SARS epidemic. In Taiwan, the first case of SARS was confirmed on March 14, 2003, with the subsequent emergence of sporadic cases.[7] The major negative influence of SARS on patients' use of hospital medical services was first noted after the first intra-hospital outbreak of the infection in a health care worker and hospitalized patients on April 22, 2003.[4,8] This is when the intra- and inter-hospital spread and transmission of SARS started, with an average of 9.3 patients (95% confidence interval, CI, 7.4, 11.1) infected per day in Taiwan until May 19, 2003.

Study population and protocol

We designated the period before March 14, 2003, as the pre-epidemic stage, and that from March 14 to April 21 as the early epidemic stage. The period from April 22 to May 19, when the clusters of hospital outbreaks began to subside, was defined as the peak epidemic stage. The period from May 20 to June 17, the day the last SARS patient was identified, was

defined as the late epidemic stage. The post-epidemic stage was from June 18 to August 31, a similar time interval as the pre-epidemic stage.

A retrospective chart review was conducted of ED medical records, and demographic information was obtained from the hospital's computer database. Patients younger than 14 years were excluded from the study. Patient data were collected on alternate days throughout the study period, and a total of 17,586 patients were recruited. Patient information that was reviewed, analyzed and compared for different stages of the SARS epidemic included age, gender, mode of arrival at hospital, triage category, time of ED visit, main diagnosis, use of ED services, and status after the ED visit. The triage category was defined as follows: category 1 — true emergency, life-threatening if not treated immediately; category 2 — emergency, moderate abnormal vital signs; category 3 — urgent, emergency condition, but not serious enough for category 2; and category 4 — non-urgent, not an emergency condition, or possibly an acute condition without the need for laboratory tests, or minor symptoms with an obvious diagnosis.[9]

Statistical analysis

Data are presented as mean ± standard deviation, or mean with 95% CIs. SPSS version 10.0 for Windows (SPSS Inc, Chicago, IL, USA) was used for data analysis. One-way analysis of variance was used for statistical analysis. A p value of less than 0.05 was considered statistically significant.

Results

In 2003, the ED handled 72,848 visits, a 14.7% decrease from 2002. At the early epidemic stage, from March 14 to April 22, 2003, there were only sporadic cases of SARS. Throughout the study period, 273 suspected SARS patients were hospitalized from the ED, among whom 75 were confirmed as SARS victims in the study hospital.

Table 1 shows that, for the peak- versus pre-epidemic SARS stage, a statistically significant decrease was noted in the total number of adult patients attending the ED each day (mean difference, 92.5 ± 8.3 patients; mean percent decrease, 43.7%; 95% CI, 39.4%, 48.0%; $p < 0.01$). This difference in patient numbers in the 2003 SARS outbreak cannot be attributed to seasonal variation, since no major difference was noted across similar time periods in 2002 (Table 1). During the peak- versus pre-epidemic SARS stage in 2003, approximately half as many

Table 1. Demographic data, mode of arrival at hospital, triage category, time of visits, and patient status at different stages of the severe acute respiratory syndrome (SARS) epidemic

	Pre-epidemic (Feb 1 to Mar 13)	Early epidemic (Mar 14 to Apr 21)	Peak epidemic (Apr 22 to May 19)	Late epidemic (May 20 to Jun 17)	Post-epidemic (Jun 18 to Aug 31)
Total visits/day					
2003	211.5 ± 32.8	188.5 ± 21.5	119.0 ± 25.7*††	123.9 ± 25.0*††	163.0 ± 16.6*
2002	187.2 ± 14.8	190.2 ± 23.3	189.6 ± 22.4	193.4 ± 23.7	199.3 ± 22.7
Mean age (yr)	57.0 ± 3.1	56.7 ± 3.6	55.1 ± 2.8	54.6 ± 3.2	55.8 ± 2.7
Male	136.4 ± 13.2 (64.5 ± 3.9)	122.7 ± 12.6 (65.1 ± 4.0)	78.0 ± 14.7 (65.6 ± 3.9)*††	78.4 ± 12.5 (63.3 ± 4.2)*††	102.1 ± 11.9 (62.7 ± 3.8)*
Age > 65 yr	101.1 ± 16.2 (47.8 ± 6.7)	91.0 ± 14.6 (48.3 ± 6.4)	50.5 ± 15.6 (42.5 ± 6.3)*††	54.3 ± 10.9 (43.8 ± 7.0)*††	72.0 ± 11.2 (44.2 ± 5.6)*††
Mode of arrival at hospital					
Private car	151.8 ± 30.1 (71.8 ± 8.3)	133.4 ± 31.4 (70.8 ± 7.2)	80.3 ± 25.2 (67.5 ± 6.7)*††	82.0 ± 21.4 (66.2 ± 6.8)*††	115.4 ± 24.7 (70.8 ± 6.5)
EMS ambulance	14.1 ± 4.1 (6.7 ± 1.8)	14.3 ± 4.2 (7.6 ± 1.8)	11.6 ± 4.8 (9.8 ± 3.2)	12.8 ± 3.6 (10.3 ± 2.8)	12.5 ± 4.3 (7.7 ± 2.3)
Private ambulance	15.0 ± 6.3 (7.1 ± 2.5)	13.4 ± 4.8 (7.1 ± 2.5)	9.3 ± 3.7 (7.8 ± 2.6)	8.3 ± 4.3 (6.7 ± 3.1)	10.3 ± 3.7 (6.3 ± 2.2)
Inter-hospital transfer	16.5 ± 5.4 (7.8 ± 2.5)	15.5 ± 5.1 (8.2 ± 2.7)	8.8 ± 4.2 (7.4 ± 2.6)	8.9 ± 4.1 (7.2 ± 3.0)	10.9 ± 3.5 (6.7 ± 2.1)
Transferred from OPD	9.4 ± 6.1 (4.4 ± 2.6)	7.8 ± 4.6 (4.1 ± 1.5)	5.6 ± 4.5 (4.7 ± 2.7)	9.0 ± 5.1 (7.3 ± 3.2)	10.7 ± 4.8 (6.6 ± 2.7)
Nursing home	4.7 ± 1.7 (2.2 ± 1.0)	4.1 ± 1.5 (2.2 ± 1.1)	3.3 ± 1.6 (2.8 ± 1.9)	2.9 ± 1.3 (2.3 ± 1.4)	3.1 ± 1.3 (1.9 ± 1.1)
Triage category					
Triage 1	24.1 ± 4.5 (11.4 ± 2.1)	21.1 ± 4.1 (11.2 ± 2.2)	20.3 ± 3.5 (17.1 ± 4.6)	20.3 ± 3.5 (16.4 ± 4.4)	18.7 ± 4.9 (11.5 ± 2.7)
Triage 2	107.2 ± 15.2 (50.7 ± 3.6)	96.3 ± 12.3 (51.1 ± 3.5)	49.7 ± 18.5 (41.8 ± 7.9)*††	54.8 ± 17.2 (44.2 ± 7.2)*††	83.9 ± 11.5 (51.5 ± 4.5)
Triage 3	77.4 ± 8.5 (36.3 ± 3.2)	68.0 ± 7.7 (36.1 ± 3.1)	45.8 ± 10.7 (38.5 ± 4.8)*†	46.3 ± 9.6 (37.4 ± 4.4)*†	57.5 ± 7.6 (35.3 ± 4.9)
Triage 4	2.7 ± 1.2 (1.3 ± 0.2)	3.0 ± 1.7 (1.6 ± 0.2)	3.1 ± 1.1 (2.6 ± 0.2)	2.5 ± 1.1 (2.0 ± 0.2)	2.8 ± 1.5 (1.7 ± 0.2)
Patient status					
Admission to ward	47.6 ± 8.7 (22.5 ± 4.7)	41.8 ± 8.4 (22.2 ± 4.6)	31.6 ± 7.7 (26.6 ± 5.1)	32.0 ± 4.6 (25.8 ± 5.3)	37.0 ± 9.1 (22.7 ± 4.7)
Admission to ICU	11.6 ± 3.4 (5.5 ± 2.0)	10.6 ± 2.4 (5.6 ± 1.6)	10.1 ± 3.0 (8.5 ± 2.1)	9.8 ± 2.8 (7.9 ± 2.2)	11.2 ± 3.3 (6.9 ± 2.1)
Discharge	152.3 ± 20.2 (72.0 ± 5.1)	136.1 ± 17.1 (72.2 ± 4.9)	77.2 ± 20.3 (64.9 ± 6.8)*††	82.1 ± 20.3 (66.3 ± 6.5)*††	114.7 ± 15.4 (70.4 ± 5.8)
Time of visits					
Early morning (0000–0800)	37.2 ± 7.0 (17.6 ± 3.2)	33.7 ± 6.9 (17.9 ± 3.1)	21.9 ± 9.0 (17.9 ± 5.4)*†	21.3 ± 6.3 (17.3 ± 5.3)*†	30.6 ± 6.8 (18.8 ± 3.3)
Day time (0800–1600)	94.3 ± 8.8 (44.6 ± 3.1)	87.7 ± 8.7 (46.5 ± 3.0)	54.1 ± 15.6 (45.5 ± 6.6)*†	53.9 ± 9.2 (43.5 ± 6.4)*†	71.0 ± 11.1 (43.6 ± 3.9)
Evening (1600–2400)	79.9 ± 9.2 (37.8 ± 4.0)	67.1 ± 11.5 (35.6 ± 4.4)	43.5 ± 10.3 (36.6 ± 5.9)*††	45.6 ± 10.2 (39.2 ± 5.8)*†	61.3 ± 7.6 (37.6 ± 3.5)

*p < 0.05 vs pre-epidemic stage; †p < 0.05 vs early epidemic stage; ††p < 0.05 vs post-epidemic stage. Data are presented as mean ± standard deviation, and as number of patients (% of total study patients), except for mean age in years. EMS = emergency medical system; ICU = intensive care unit; OPD = outpatient department.

patients (this was a significant decrease, $p < 0.05$) in the following categories attended the ED: the elderly (age > 65 years); ED arrival by private car; triage categories 2 and 3; discharge after ED visit; and early morning, daytime or evening ED visit. However, for these parameters, the overall percentages of all study patients attending the ED were not significantly affected by the SARS epidemic. For the peak- versus pre-epidemic SARS stage, the mean numbers of patients who were transported to the ED by ambulance, inter-hospital transfer, from outpatient departments, or from nursing homes, were not significantly reduced. Interestingly, the numbers of patients in triage category 1, or admitted to a ward or intensive care unit (ICU) after the ED visit were comparable across all study stages.

The mean numbers of patients attending the ED with a principal diagnosis of upper respiratory tract infection, or suicide attempt via drug overdose, were greater during the peak-epidemic stage than all other epidemic stages; however, these differences were not statistically significant (Table 2). For the peak- versus pre-epidemic SARS stages, statistically significant decreases ($p < 0.05$) were noted in the mean numbers of patients attending the ED with the following principal diagnoses: cardiovascular disease, –12.6 (95% CI, –8.9, –16.4); inflammatory or functional bowel disease, –15.6 (95% CI, –9.9, –21.4); endocrine disease, –2.5 (95% CI, –1.9, –3.1); dizziness or vertigo, –4.5 (95% CI, –2.0, –7.9); and trauma, –26.0 (95% CI, –22.1, –30.6). Nevertheless, the total percent of patients in each diagnostic category who attended the ED did not change significantly across the various stages of the SARS epidemic (Table 2).

Discussion

Before April 22, 2003, only sporadic SARS cases had presented that did not result in a significant decrease in the use of medical services, including inpatient, ambulatory and dental care, and Chinese medicine.[8] After the first nosocomial SARS outbreak on April 22, the fears of SARS transmission began to keep patients from visiting hospitals. Significant reductions in the use of inpatient care (–35.2%), ambulatory care (–23.9%), dental care (–25.3%), and Chinese medicine (–5.8%) were noted at the peak of the SARS epidemic in Taiwan.[8] Our study demonstrates that the SARS epidemic had a great impact in reducing total ED patient attendances, with a decrease similar to that reported previously.[6] However, a marked decrease was also noted in the

number of patients arriving at the ED by private car, and in the number in triage categories 2 or 3.

In addition, we extensively investigated the effect of the SARS epidemic on principal diagnoses among patients attending the ED during pre-, early-, peak-, late-, and post-epidemic stages. Anxiety about SARS acquisition prevented patients from attending the hospital or ED because of scientific uncertainty and because the infection is highly contagious and can cause critical illness and death.[6,10,11] However, even at the peak of the SARS outbreak, patients with true emergencies or needs for intensive care still arrived at the ED, either by ambulance or transferred from an ambulatory unit or another hospital. Indeed, our results show that the numbers of patients arriving at the ED by ambulance, in triage category 1, with critical illness, or requiring ward or ICU admission, were not influenced by the SARS epidemic. This indicates that emergency medical services remained imperative throughout the entire SARS epidemic, and suggests limited anxiety about the likelihood of acquiring SARS in a standard protective environment in a SARS-dedicated hospital among patients with critical illness who needed to visit the ED.[12,13]

We suggested that the SARS epidemic would reduce medical-service use in the various categories of ED disease, and that such reduced medical-service use would correlate highly with the overall decrease in patient numbers attending the ED. The numbers of patients with any of various principal ED diagnoses were expected to be reduced during the SARS epidemic, in line with the overall decrease in the number of ED attendees. Our study results showed that patients with upper respiratory tract infection, or those who attempted suicide with a drug overdose, increased in number during the peak-epidemic stage, but these increases were not statistically significant. Among other principal diagnoses, significant decreases ($p < 0.05$) in patient numbers were noted, in the peak- versus pre- and early-epidemic stages, for cardiovascular disease, inflammatory or functional bowel disease, endocrine disease, dizziness or vertigo, and trauma. These results provide important information, including absolute patient numbers and relative proportions, about the quantitative effects of SARS on changes in individual, principal diagnoses in ED patients. Our results also support the evidence that the SARS epidemic placed tremendous psychologic stress on people, and caused about 50% of potential patients to not visit a hospital[10] or an ED[6] unless they highly suspected themselves to have SARS, or had an urgent or emergency condition.

Several reasons, including tertiary referral of patients with fever to the ED, cases of unexpected SARS, and

Table 2. Principal diagnoses in ED patients at different stages of the 2003 SARS epidemic

Principal diagnosis	Pre-epidemic (Feb 1 to Mar 13)	Early epidemic (Mar 14 to Apr 21)	Peak epidemic (Apr 22 to May 19)	Late epidemic (May 20 to Jun 17)	Post-epidemic (Jun 18 to Aug 31)
Upper RTI	13.3 ± 4.4 (6.3 ± 2.0)	11.7 ± 2.9 (6.2 ± 1.7)	16.4 ± 7.0 (13.8 ± 7.8)	6.7 ± 4.5 (5.4 ± 5.2)	8.8 ± 3.0 (5.4 ± 1.6)
Lower RTI	13.3 ± 6.0 (6.3 ± 2.9)	12.8 ± 6.2 (6.8 ± 3.0)	7.5 ± 4.1 (6.3 ± 2.7)	7.2 ± 2.5 (5.8 ± 2.3)	9.9 ± 3.0 (6.1 ± 1.5)
SARS	0	0.9 ± 0.9 (0.5 ± 0.5)	3.1 ± 2.5 (2.6 ± 1.8)*†	0.7 ± 1.5 (0.6 ± 0.4)	0
Other infectious disease	14.8 ± 5.2 (7.0 ± 3.1)	12.6 ± 6.0 (6.7 ± 3.0)	10.2 ± 6.1 (8.6 ± 4.1)	9.7 ± 4.8 (7.8 ± 3.7)	12.7 ± 5.3 (7.8 ± 3.3)
Hematologic & neoplastic disease	13.7 ± 4.4 (6.5 ± 1.9)	12.8 ± 3.2 (6.8 ± 2.1)	9.5 ± 5.2 (8.0 ± 3.5)	8.1 ± 2.5 (6.5 ± 2.7)*†	11.9 ± 5.3 (7.3 ± 2.9)
CVD	20.7 ± 4.5 (9.8 ± 2.5)	18.3 ± 4.4 (9.7 ± 2.4)	8.1 ± 3.4 (6.8 ± 2.7)*†	8.7 ± 3.2 (7.0 ± 2.3)*†	13.0 ± 4.3 (8.0 ± 2.7)
Inflammatory or functional bowel disease	23.9 ± 5.2 (11.3 ± 2.6)	20.9 ± 5.3 (11.1 ± 2.5)	8.3 ± 4.3 (7.0 ± 2.0)*†	11.2 ± 4.0 (9.0 ± 1.8)	15.6 ± 5.1 (9.6 ± 2.4)
Hepatobiliary tract disease	6.8 ± 2.3 (3.2 ± 1.1)	5.8 ± 1.8 (3.1 ± 0.9)	4.9 ± 1.4 (4.1 ± 1.6)	5.3 ± 2.0 (4.3 ± 1.4)	5.4 ± 2.4 (3.3 ± 1.5)
Other GI disease	7.4 ± 3.3 (3.5 ± 1.6)	7.9 ± 3.4 (4.2 ± 2.0)	3.8 ± 1.2 (3.2 ± 2.0)	5.6 ± 2.1 (4.3 ± 1.9)	6.8 ± 2.2 (4.2 ± 2.0)
Rheumatologic disease	4.7 ± 2.5 (2.2 ± 1.5)	5.3 ± 2.4 (2.8 ± 1.4)	2.4 ± 1.8 (2.0 ± 1.6)	3.3 ± 2.1 (2.7 ± 1.7)	3.9 ± 2.7 (2.4 ± 1.6)
Renal insufficiency or failure, & electrolyte imbalance	3.0 ± 1.5 (1.4 ± 1.0)	2.3 ± 1.5 (1.2 ± 0.9)	1.9 ± 1.6 (1.6 ± 1.0)	1.5 ± 0.6 (1.2 ± 0.9)	2.1 ± 1.4 (1.3 ± 0.9)
Suicide attempt with drug overdose	2.5 ± 1.8 (1.2 ± 1.0)	2.5 ± 1.9 (1.3 ± 1.0)	3.3 ± 1.8 (2.8 ± 1.5)	2.4 ± 1.5 (2.4 ± 1.4)	2.3 ± 1.4 (1.4 ± 1.0)
Endocrine disease	3.0 ± 0.6 (1.4 ± 1.4)	2.5 ± 0.7 (1.3 ± 1.2)	0.5 ± 0.7 (0.4 ± 0.3)*†	1.7 ± 1.2 (1.4 ± 1.0)	2.0 ± 1.5 (1.2 ± 1.0)
Dizziness / vertigo	6.3 ± 3.3 (3.0 ± 1.7)	6.4 ± 3.3 (3.4 ± 2.5)	1.8 ± 0.8 (1.5 ± 1.9)*†	3.8 ± 2.6 (3.1 ± 2.2)	5.2 ± 2.9 (3.2 ± 1.7)
CVA	8.5 ± 3.2 (4.0 ± 1.6)	8.3 ± 3.6 (4.4 ± 1.5)	5.2 ± 1.7 (4.4 ± 1.7)	5.1 ± 1.6 (4.1 ± 1.5)	7.0 ± 3.0 (4.3 ± 2.1)
Genitourinary disease	7.0 ± 3.4 (3.3 ± 2.0)	6.6 ± 4.0 (3.5 ± 2.1)	3.9 ± 1.8 (3.3 ± 1.8)	4.0 ± 1.4 (3.2 ± 1.7)	6.0 ± 2.5 (3.7 ± 1.6)
Trauma	44.2 ± 8.5 (20.9 ± 3.3)	33.4 ± 7.1 (17.7 ± 3.4)	18.2 ± 7.4 (15.3 ± 5.2)*††	27.0 ± 7.3 (21.8 ± 4.9)*	35.8 ± 6.2 (22.0 ± 3.4)
Psychiatric problem / disease	7.0 ± 2.3 (3.3 ± 2.1)	6.0 ± 2.1 (3.2 ± 2.0)	3.3 ± 2.2 (2.8 ± 1.8)	3.8 ± 2.2 (3.1 ± 1.6)	5.2 ± 2.2 (3.2 ± 2.0)
DOA	0.8 ± 0.3 (0.4 ± 0.3)	1.5 ± 0.9 (0.8 ± 0.6)	0.5 ± 0.3 (0.4 ± 0.7)	0.7 ± 0.3 (0.6 ± 0.8)	0.7 ± 0.4 (0.4 ± 0.4)
Other	10.6 ± 4.2 (5.0 ± 2.0)	10.0 ± 4.0 (5.3 ± 2.1)	6.1 ± 3.2 (5.1 ± 2.4)	7.4 ± 3.0 (6.0 ± 2.1)	8.5 ± 4.1 (5.2 ± 2.2)

*$p < 0.05$ vs pre-epidemic stage; †$p < 0.05$ vs early epidemic stage; ‡$p < 0.05$ vs post-epidemic stage. Data are presented as mean number of patients ± standard deviation (% of total study patients). CVA = cerebrovascular accident; CVD = cardiovascular disease; DOA = dead on arrival; GI = gastrointestinal; RTI = respiratory tract infection; SARS = severe acute respiratory syndrome.

a hospital dedicated to SARS care, may explain the greater impact of the SARS epidemic on ED care (reduced by 43.7% in this study) than on overall ambulatory care (reduced by 23.9%) in Taiwan.[8] Because of the likelihood of a long-term fight against new or ongoing SARS outbreaks, the emergency physician workforce and ED medical resources should be flexible and easily adjusted, in line with the substantial results from this study.

There are several limitations to this study. First, we could not predict the effects of a longer SARS epidemic, involving a greater number of patients, on the duration or amplitude of decreases in ED attendances, or on further changes in ED disease patterns. Second, spontaneous rather than SARS-induced changes in disease patterns may have occurred in our ED, although no significant differences in such patterns were noted between pre- and post-epidemic stages. Third, our study design was restricted to information obtained from a SARS-dedicated, tertiary medical center. The effects of the SARS outbreak on our study parameters in non-SARS-dedicated medical centers, community hospitals, and private hospitals or clinics, were not evaluated. Moreover, we did not investigate what impact a SARS outbreak would have on the closure of emergency services.

In conclusion, the SARS outbreak, especially during the peak-epidemic stage, had a great impact in terms of reducing patient attendances at, and changing disease patterns in, the ED of a SARS-dedicated hospital. These results provide invaluable information for the design of new schedules of emergency medical services, workforces of emergency physicians and other specialists, and hospital admission and management systems, to deal with any future reappearance of a SARS epidemic or other infectious outbreak.

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