

Loss of Paramedic Availability in an Urban Emergency Medical Services System during a Severe Acute Respiratory Syndrome Outbreak

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Abstract

Objectives: To describe the loss of paramedic availability to Toronto Emergency Medical Services during a biphasic (SARS-1 and SARS-2) outbreak of severe acute respiratory syndrome (SARS). **Methods:** During the SARS outbreak, a dedicated paramedic surveillance and quarantine program was developed. The authors determined the number of paramedics on quarantine each day, the type of quarantine (either home quarantine [HQ] or work quarantine [WQ]), and the development of SARS-like symptoms. **Results:** During the SARS outbreak, there were five cases of probable SARS and three cases of suspect SARS. SARS-1 lasted 30 days, during which 234 paramedics were placed on HQ. The total number of HQ days was 1,615. During the five peak days of SARS-1, the total number of HQ days was 664. SARS-2 lasted 18 days, during which 292 paramedics were placed on either HQ or WQ, for a combined number of quarantine days of 1,637. During the five peak days of SARS-2, the combined number of quarantine days was 910.

Of these, paramedics were available for duty on 708 days (78%) due to the WQ program. The primary reason for quarantine was unprotected exposure to a health care institution experiencing a SARS outbreak. Under quarantine, SARS-like symptoms developed in 68 paramedics, including cough (53 [78%]), myalgia (33 [48%]), fatigue (30 [44%]), headache (29 [43%]), fever (11 [16%]), and shortness of breath (7 [10%]). **Conclusions:** Paramedics were among the health care workers who developed SARS. During SARS-2, WQ optimized the number of days on which paramedics were available for duty. Many paramedics developed SARS-like symptoms without being diagnosed as having SARS. A dedicated paramedic surveillance and quarantine program provided a useful means to manage the paramedic resource during the SARS outbreak. **Key words:** SARS virus; emergency medical services; quarantine; paramedic. *ACADEMIC EMERGENCY MEDICINE* 2004; 11: 973–978.

Severe acute respiratory syndrome (SARS) is a viral infection linked to a newly characterized coronavirus.^{1,2} Initial cases appear to have originated in China and Hong Kong and subsequently spread to multiple countries worldwide. The emergence of SARS in Hong Kong and Toronto has previously been described.^{3–5}

Ontario declared a SARS emergency under the Emergency Plans Act on March 26, 2003. The original SARS outbreak (SARS-1) was officially declared over by the World Health Organization on May 14, 2003. However, a second phase of the original SARS outbreak (SARS-2) was reported on May 23, 2003,^{6,7} when

new undetected cases of SARS were identified. The SARS-2 outbreak was declared over on July 2, 2003, by which time Ontario experienced 247 cases of probable SARS, 128 cases of suspect SARS, and, as of August 13, 2003, 44 deaths.^{8,9}

In response to the SARS outbreak, a program of contact tracing, quarantine, and medical surveillance of paramedics was implemented by Toronto Emergency Medical Services (EMS) and base hospital of Sunnybrook and Women's College Health Sciences Centre.

In this report, we describe the emergence of SARS and SARS-like symptoms (SLS) in our paramedics and how quarantine measures affected the availability of paramedics for duty during the SARS outbreak. This information may prove to be important should a future outbreak occur requiring a similar response in another urban center.

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METHODS

Study Design. This was a prospective observational study of paramedics working in Toronto during the SARS outbreak. Our research was approved by the ethics board of Sunnybrook and Women's College Health Sciences Centre.

Study Setting and Population. Toronto EMS is the largest municipal EMS service in Canada, with 920 paramedics and a fleet of 140 ambulances serving 2.5 million citizens.

Study Protocol. Paramedics were reported as having either suspect or probable SARS using the case definition according to Health Canada.¹⁰ Suspect SARS included fever (temperature $>38^{\circ}\text{C}$), one or more respiratory symptoms (either cough, shortness of breath, or difficulty breathing), and a positive epidemiologic history. Probable SARS included meeting the case definition for suspect SARS and having a severe progressive respiratory illness suggestive of acute respiratory syndrome of no known cause, or a chest radiograph with findings of atypical pneumonia of no known cause. SLS included the presence of one of the following symptoms: myalgia, extreme fatigue, severe headache, cough, shortness of breath, or fever experienced during the SARS outbreak.

Personal protective equipment (PPE) was worn to protect paramedics from transmission of SARS. PPE consisted of nitrile gloves, gown, N95 respirator, and protective eyewear. Paramedics were advised to wear gloves, mask, and gown for patients with "an acute febrile illness" on March 14, 2003. Protective eyewear was added on March 17, 2003. The presence of SARS in Toronto was first declared publicly on March 21, 2003. PPE was advised for all patient contacts on March 31, 2003. No PPE was worn from May 17 to May 22, 2003, inclusive, in keeping with the declaration of the end of the SARS outbreak by the World Health Organization. Paramedics not wearing PPE during an institutional or patient exposure are described as being unprotected.

Home quarantine (HQ) was defined as keeping asymptomatic paramedics with a history of unprotected exposure to a SARS-affected hospital or to a patient with suspect/probable SARS under home observation for ten days from the last known exposure date.

Work quarantine (WQ) was defined as keeping asymptomatic paramedics with a history of unprotected exposure to a SARS-affected hospital during the SARS-2 outbreak on duty while wearing PPE at all times. These paramedics were also required to follow HQ procedures when not on duty. Paramedics on WQ were placed on HQ if SLS developed (i.e., the paramedic was not permitted to report for duty).

During SARS-1, paramedics who developed a temperature $>38^{\circ}\text{C}$ were placed on HQ regardless of the exposure history. During SARS-2, paramedics were required to self-screen daily for SLS. Paramedics who developed any SLS were placed on HQ regardless of their exposure history.

While on quarantine, paramedics were required to perform daily self-screening for the development of SLS. Paramedics who developed SLS remained on quarantine until they met pre-established criteria for

terminating quarantine. In general, termination of quarantine required a symptom-free period of 48 hours, a fever-free period of 72 hours, or seven days of SLS without the development of a fever.

Key Outcome Measures. The following information was tracked daily: the number of paramedics with probable SARS, suspect SARS, and SLS and the number of paramedics on HQ or WQ. Paramedics who were quarantined more than once were reported as separate quarantine events. Lastly, we recorded the primary reason for quarantine.

Data Analysis. Data were entered and analyzed using Microsoft Access 2002 and Microsoft Excel 2002 (Microsoft Corp., Redmond, WA).

RESULTS

Five paramedics developed probable SARS (four during SARS-1 and one during SARS-2) (Table 1), and three paramedics developed suspect SARS (all SARS-1). All paramedics who developed probable SARS were exposed to at least one of the initial cluster of patients during SARS-1⁴ or SARS-2. During SARS-1, contacts with undiagnosed symptomatic patients occurred during the time when directives for paramedics to wear PPE were not in effect. The paramedic exposed during SARS-2 was wearing recommended PPE but had not been fit-tested for an N95 respirator. This paramedic subsequently failed fit-testing at a later date.

During SARS-1, public quarantine notices (announced during a 12-day span between March 25 and April 5, 2003) affected three hospitals and included 32 calendar days on which exposure to an affected hospital required quarantine. During SARS-2, public quarantine notices (announced over two days between May 23 and May 25, 2003) affected three entirely different hospitals and included 28 calendar days on which quarantine was required.^{11,12}

The SARS-1 quarantine and medical surveillance program, defined as the interval from the first paramedic being placed on HQ to all paramedics returning to duty (except those who had contracted probable SARS), lasted 30 days. During SARS-1, 234 paramedics were placed on HQ. Figure 1 shows the quarantine curve identifying the number of paramedics on HQ during each day of SARS-1. The total number of quarantine days was 1,615. The peak number of paramedics on quarantine during SARS-1 was 146 on day 12. During the five peak days of SARS-1, the total number of HQ days was 664.

The SARS-2 quarantine program lasted 18 days. During SARS-2, 292 paramedics were placed on either HQ or WQ. Figure 2 shows the quarantine curve identifying the number of paramedics on either HQ or WQ during each day of SARS-2. The combined

TABLE 1. Clinical Highlights of Paramedics Who Developed Probable SARS

	Exposure History	Time from Exposure to Symptom Onset	Duration of Hospitalization	Duration of Quarantine After Discharge	Duration from Symptom Onset to Return to Duty
Paramedic A	<p>March 5, 2003 Unprotected exposure during SARS-1 Performed ACLS on index SARS-1 case; interviewed symptomatic SARS-1 son of index case, both of whom died from probable SARS.</p> <p>March 14, 2003 Possible in ED at same time as an undiagnosed symptomatic patient who subsequently died from probable SARS.</p> <p>March 16, 2003 Possible in ED at same time as patient transported by Paramedics B and C.</p>	Between 2 and 4 days (Symptoms began March 18)	8 days	10 days	33 days
Paramedic B	<p>March 16, 2003 Unprotected exposure during SARS-1 Transported undiagnosed symptomatic patient who subsequently died from probable SARS.⁵</p>	3 days	5 days	10 days	50 days
Paramedic C	Same as Paramedic B	2 days	ICU 12 days (not intubated) Ward 7 days	7 days	70 days
Paramedic D (EMS Supervisor)	<p>March 16, 2003 Interviewed patient transported by Paramedics B and C when patient was in the ED</p>	12 days	12 days	35 days	110 days
Paramedic E	<p>May 12, 2003 Protected exposure during SARS-2 Transported undiagnosed symptomatic index SARS-2 patient</p>	4 days	7 days	1 day	15 days

ACLS = Advanced cardiac life support; ED = emergency department.

number of HQ and WQ days was 1,637. The peak number of paramedics on quarantine during SARS-2 was 236 on day 7 (78 paramedics on HQ and 158 paramedics on WQ).

During the five peak days of SARS-2, the combined number of HQ and WQ days was 910. Of these, paramedics were available for work on 708 days (78%) due to the WQ program.

Overall, 526 paramedics were quarantined during SARS-1 and SARS-2 combined. Most paramedics (389 [74%]) required quarantine due to unprotected exposure to a SARS-affected hospital, followed by 75 (14%) who had unprotected exposure to a colleague with SLS, 43 (9%) who developed SLS while not on quarantine, and 19 (4%) who had unprotected exposure to patients with SLS.

During SARS-1 and SARS-2, SLS developed in 68 of the 526 paramedics (13%) under quarantine. The following SLS developed in these 68 paramedics: cough (53 [78%]), myalgia (33 [48%]), fatigue (30 [44%]), headache (29 [43%]), fever (11 [16%]), and shortness of breath (7 [10%]).

DISCUSSION

Paramedics were among the first health care workers in our community to be exposed to SARS during the outbreak. A review of the initial nine cases of SARS⁵ identified in Toronto showed that paramedics were involved in providing care to four of these patients. Most paramedics who contracted SARS were off duty for prolonged periods, primarily due to fatigue and dyspnea on exertion typical of many patients convalescing from SARS.¹³

The effect of the chronology of public quarantine notices on the quarantine curves comparing SARS-1 and SARS-2 (Figures 1 and 2, respectively) is remarkable. Overall, the number of paramedics who required quarantine during SARS-1 and SARS-2 (234 vs. 292, respectively) and the total number of quarantine days (1,615 vs. 1,637, respectively) were similar. However, the quarantine curve peaked later in SARS-1 compared with SARS-2 (day 12 vs. day 7, respectively) and lasted longer (30 days vs. 18 days, respectively). Compared with SARS-1, SARS-2 led to a greater

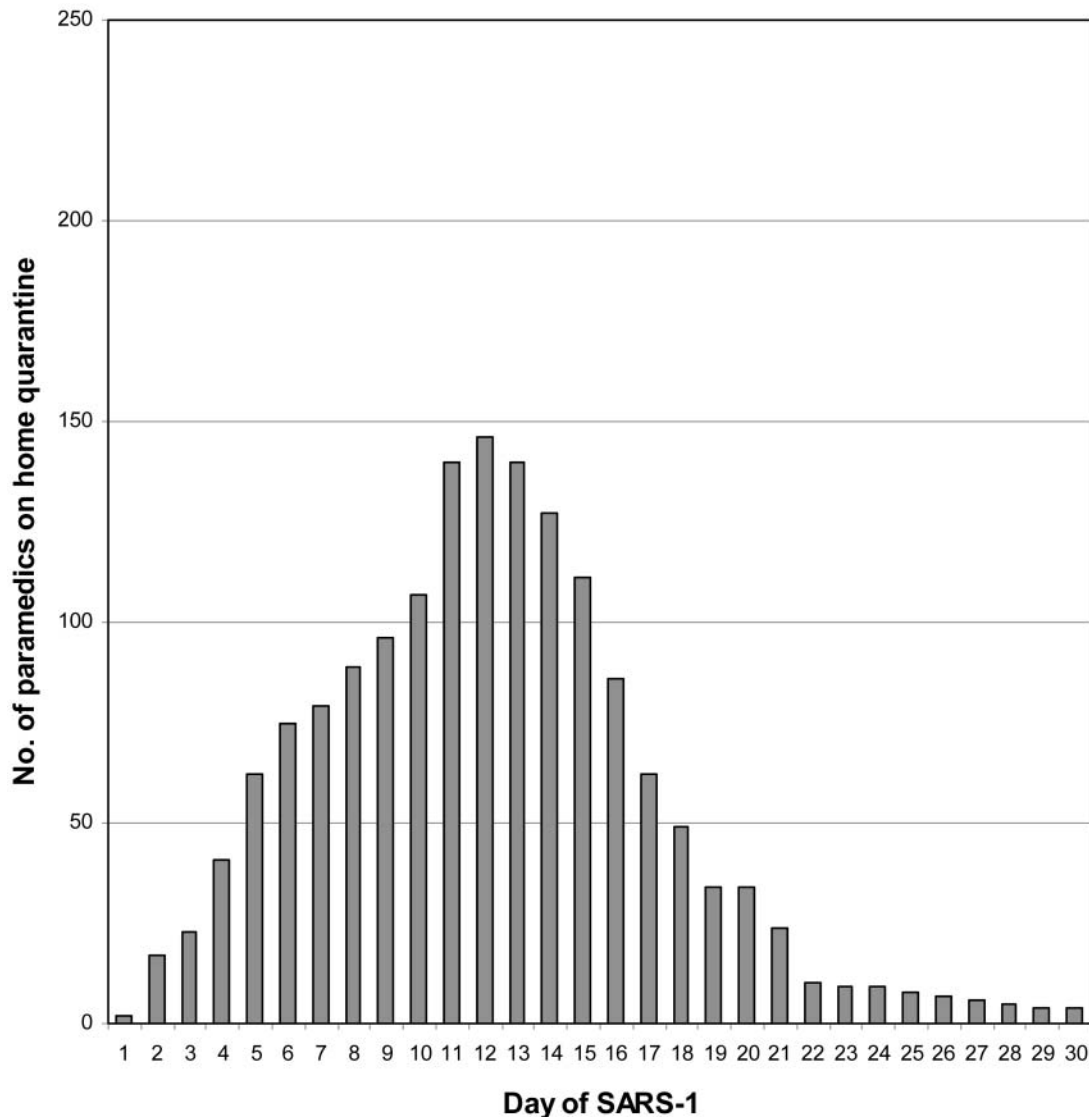


Figure 1. SARS-1 quarantine curve: number of paramedics on home quarantine (HQ) during each day of SARS-1. SARS = severe acute respiratory syndrome.

number of paramedics who were unavailable for duty at the peak of the curve (146 vs. 236, respectively) and a greater number of quarantine days during the five-day peak (664 vs. 910, respectively).

To optimize paramedic availability during SARS-2, a WQ program was developed. The WQ program allowed asymptomatic paramedics with a low-risk exposure (i.e., unprotected exposure to a SARS-affected hospital) to continue working, while paramedics with a high-risk exposure (i.e., unprotected exposure to a patient with suspect or probable SARS) were not permitted to work (i.e., they followed HQ). During WQ, all paramedics on duty were required to wear PPE at all times, including those who had no known exposure history. In this way, all on-duty paramedics were protected from each other regardless of their exposure history.

During the five peak days of SARS-2, the WQ program resulted in paramedics' being available for duty on 78% of the quarantine days (708 of 910 days).

Had HQ been the only quarantine process in place during SARS-2, paramedics would have been unavailable for duty for these 708 days.

Most paramedics required quarantine due to an unprotected exposure to a hospital with a SARS outbreak. Between SARS-1 and SARS-2, there was a five-day period during which paramedics were not required to wear PPE based on a World Health Organization declaration that the SARS outbreak had ended. If paramedics had continued to wear PPE during these five days, there would have been no need to quarantine any asymptomatic paramedic with a hospital exposure during SARS-2. A substantial number of paramedics were also quarantined due to unprotected exposure to colleagues who had developed SLS following treatment of patients with SARS or SLS. This emphasizes the need for an EMS system to be able to rapidly identify and notify all paramedics who require quarantine.

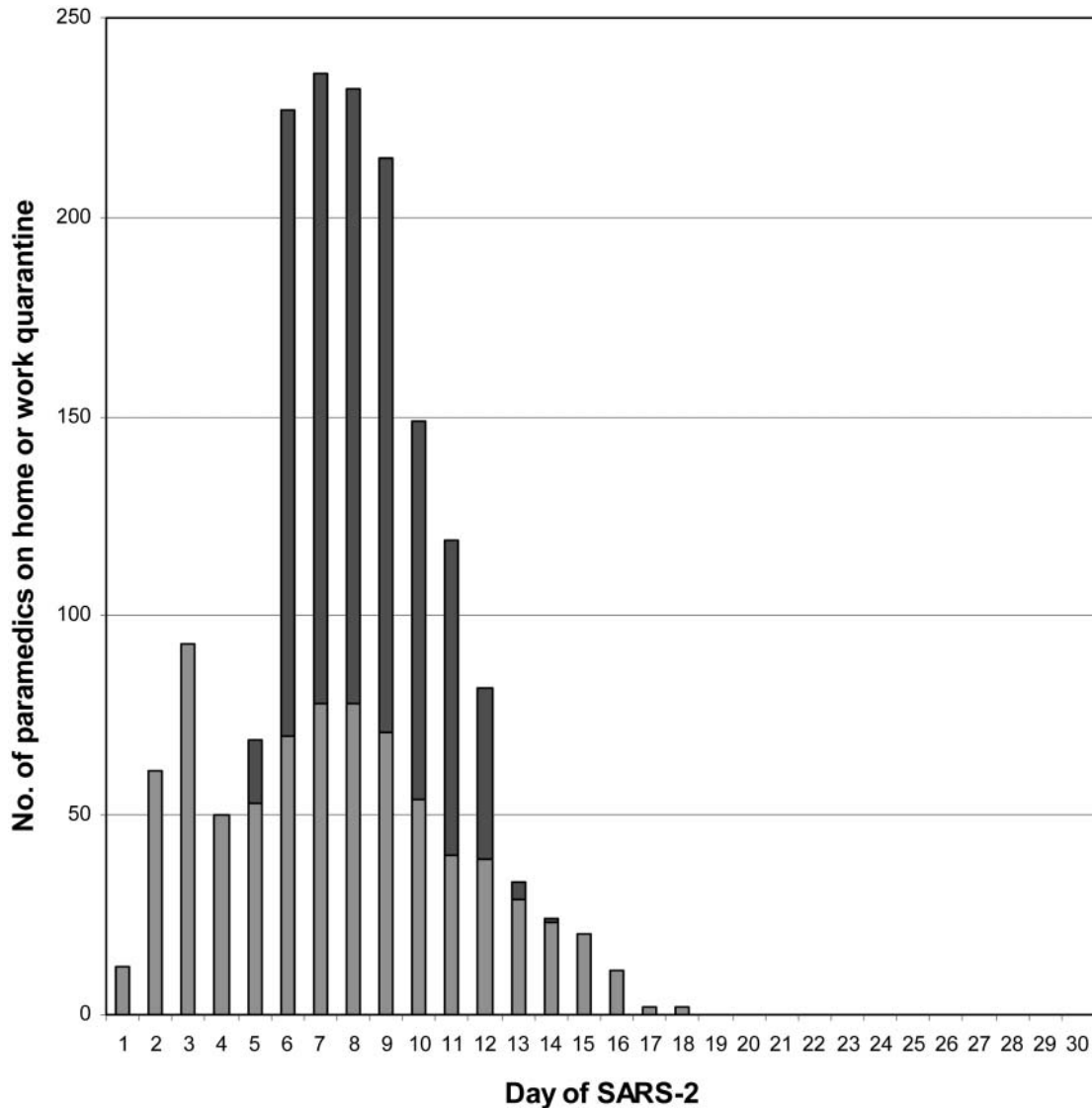


Figure 2. SARS-2 quarantine curve: number of paramedics on home quarantine (HQ) or work quarantine (WQ) during each day of SARS-2 (HQ = light bars; WQ = dark bars). SARS = severe acute respiratory syndrome.

While under quarantine, 68 paramedics developed SLS, resulting in a great deal of anxiety among paramedics. Included in this group are the three paramedics who developed suspect SARS and paramedics D and E who developed probable SARS after the medical support unit became operational. The medical support unit identified each of these individuals as part of our surveillance program. In addition, the medical support unit played a crucial role in deciding which paramedics required formal medical evaluation and when paramedics were fit to return to duty and providing advice to paramedics regarding concerns about their well-being.

LIMITATIONS

It was difficult to identify all paramedics who required either HQ or WQ because the records of which paramedics attended a specific hospital during a de-

finied time interval were not always complete. Tracing of paramedics in contact with a symptomatic colleague required us to establish the movements of the affected paramedic during the time that he or she was symptomatic while on duty. We cannot be certain that we identified all paramedics who actually required quarantine. Lastly, our experiences with SARS pertain to a single EMS system and may not reflect the experience of other EMS systems in the event of a future SARS outbreak.

CONCLUSIONS

Paramedics were among the first health care workers to be exposed to and develop SARS during SARS-1 and SARS-2. During SARS-2, WQ optimized the number of days on which paramedics were available for duty. Many paramedics developed SLS without being diagnosed as having SARS. A dedicated paramedic

surveillance and quarantine program provided a useful means to manage the paramedic resource during the SARS outbreak. The EMS system must be prepared to respond quickly to a SARS outbreak to protect its workforce from potential exposures to SARS.

This report is dedicated to all Toronto EMS paramedics who responded to the SARS outbreak with the highest degree of professionalism and bravery and to the paramedic staff of the Medical Support Unit who were an unending source of reassurance and compassion to their colleagues on the road. The authors also acknowledge the valuable support of Toronto Public Health and the Provincial SARS Operations Centre.

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