

ORIGINAL ARTICLE

# Public Health Measures to Control the Spread of the Severe Acute Respiratory Syndrome during the Outbreak in Toronto

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## ABSTRACT

### BACKGROUND

Toronto was the site of North America's largest outbreak of the severe acute respiratory syndrome (SARS). An understanding of the patterns of transmission and the effects on public health in relation to control measures that were taken will help health officials prepare for any future outbreaks.

### METHODS

We analyzed SARS case, quarantine, and hotline records in relation to control measures. The two phases of the outbreak were compared.

### RESULTS

Toronto Public Health investigated 2132 potential cases of SARS, identified 23,103 contacts of SARS patients as requiring quarantine, and logged 316,615 calls on its SARS hotline. In Toronto, 225 residents met the case definition of SARS, and all but 3 travel-related cases were linked to the index patient, from Hong Kong. SARS spread to 11 (58 percent) of Toronto's acute care hospitals. Unrecognized SARS among inpatients with underlying illness caused a resurgence, or a second phase, of the outbreak, which was finally controlled through active surveillance of hospitalized patients. In response to the control measures of Toronto Public Health, the number of persons who were exposed to SARS in nonhospital and nonhousehold settings dropped from 20 (13 percent) before the control measures were instituted (phase 1) to 0 afterward (phase 2). The number of patients who were exposed while in a hospital ward rose from 25 (17 percent) in phase 1 to 68 (88 percent) in phase 2, and the number exposed while in the intensive care unit dropped from 13 (9 percent) in phase 1 to 0 in phase 2. Community spread (the length of the chains of transmission outside of hospital settings) was significantly reduced in phase 2 of the outbreak ( $P < 0.001$ ).

### CONCLUSIONS

The transmission of SARS in Toronto was limited primarily to hospitals and to households that had had contact with patients. For every case of SARS, health authorities should expect to quarantine up to 100 contacts of the patients and to investigate 8 possible cases. During an outbreak, active in-hospital surveillance for SARS-like illnesses and heightened infection-control measures are essential.

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**F**ROM FEBRUARY TO JULY 2003, TORONTO experienced the largest outbreak of the severe acute respiratory syndrome (SARS) outside Asia. A diagnosis of SARS was given to 225 patients according to Health Canada criteria. SARS is a newly emerged infectious respiratory illness that has been well described.<sup>1-10</sup> The human and economic consequences of the SARS outbreak in Toronto have been far-reaching. On April 23, 2003, the World Health Organization (WHO) issued an advisory against travel to Toronto.<sup>11</sup> Although it was withdrawn six days later, the advisory had a costly effect. The tourism industry lost \$260 million (Canadian), and 11 percent of businesses related to tourism reported layoffs.<sup>12,13</sup> In Ontario, provincial government costs of coping with SARS have been estimated at \$1.13 billion (Canadian).<sup>14</sup>

The Toronto outbreak was unique in having two distinct phases, the second occurring after the outbreak was prematurely declared over. This article describes the SARS outbreak in relation to the public health measures taken to control it. The data presented here will help health care professionals, hospital personnel, and public health officials understand how the disease spreads and decide where and how to focus resources and control measures.

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## METHODS

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### STUDY DESIGN

We analyzed Toronto Public Health data and compared control measures, community spread, and quarantine efforts in the two phases of the outbreak. We were able to compare the risk factors in cases during the implementation of initial infection-control measures (phase 1) with the risk factors afterward (phase 2). Phase 1 (February 23 to April 21, 2003) is defined as the time from the onset of illness in the index travel-related patient until the onset of illness in the last patient identified as having SARS before the outbreak was first declared over. Phase 2 (April 22 to July 1, 2003) extended from the end of phase 1 until two incubation periods (defined as the greatest length of time between exposure and the onset of symptoms: 10 days) after the onset of the last recognized case in Toronto. We used letters of the alphabet to identify Toronto hospitals according to the order of the onset of cases (e.g., Hospital A recorded the first case of SARS). Local health units in municipalities adjacent to Toronto were responsible for managing cases and contacts among their residents. To ensure consis-

tency of data collection and interpretation, we restricted our analysis to data on Toronto residents.

### SETTING

Toronto, the capital of the province of Ontario, is Canada's largest city, with an ethnically diverse population of 2.5 million. Toronto's international airport handled 14.5 million international passenger trips in 2002.<sup>15</sup> The city has 19 acute care hospitals with emergency departments. Residents of Toronto are insured for all essential health services through a single universal provincial insurance plan.

### INITIAL INVESTIGATION AND CONTROL

On March 13, 2003, one day after the WHO issued its first global alert about "atypical pneumonia," Toronto Public Health reported Toronto's first case of SARS. Figure 1 summarizes the progression of important dates and interventions during the outbreak. Community awareness was heightened by prominent daily media coverage. Toronto Public Health investigated and tracked all potential cases of SARS that were reported by clinicians, and it identified and quarantined contacts of patients. All cases of SARS were isolated and treated in a hospital. Institutions where the transmission of SARS occurred were evaluated, and infection-control measures were implemented by public health teams together with hospital staff. The provincial Ministry of Health required hospitals throughout the province to ban all nonessential staff members and visitors except on compassionate grounds (e.g., a parent visiting an ill child) and to suspend all outpatient and elective inpatient care. Hospitals were required to screen all patients, staff members, and visitors for risk factors for and symptoms of SARS, and workers were required to use gloves, gowns, eye protection, and N95 respirators for all contact with patients. Similar measures were instituted for outpatient sites, and clinics were established for the assessment of SARS.

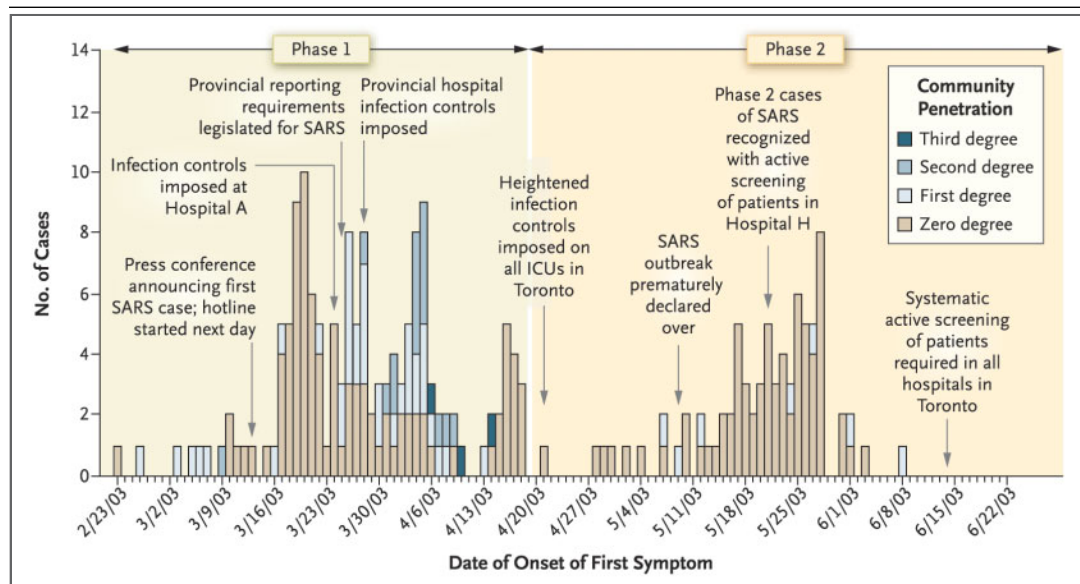
Persons with potential cases of SARS were cared for as if they had SARS until the illness was ruled out. All potential SARS cases were classified according to Health Canada case definitions as "probable" or "suspect" or as not meeting the case definition.<sup>16</sup> Patients with suspect cases had had close contact with a patient with SARS, had a fever of 38°C or higher, and had new shortness of breath or cough. These cases were reclassified as probable if radiographic or autopsy findings were consistent with pneumonia or the respiratory distress syn-

drome or if an assay for SARS-associated coronavirus (SARS-CoV) was positive. If an alternative diagnosis could fully explain the illness, then SARS was ruled out. When laboratory assays for SARS-CoV became available in phase 2, serologic tests of multiple acute- and convalescent-phase blood samples were performed, in addition to polymerase-chain-reaction (PCR) tests, in patients with SARS and those with potential cases of SARS.

Toronto Public Health staff identified close contacts of patients through interviews, reviews of patient and visitor logs, and employee schedules in institutions where the transmission of SARS occurred. Close contacts (henceforth referred to as contacts) were people who cared for, lived with, or had face-to-face contact (within 1 m) with a person with SARS or direct contact with the respiratory secretions or bodily fluids of a person with SARS.<sup>16</sup> Contacts who had SARS-like symptoms were referred for medical assessment. Public health staff instructed asymptomatic contacts to stay at home under quarantine for the 10 days after the last expo-

sure, provided support, and monitored the contacts for the onset of symptoms and compliance. The instructions for quarantine included sleeping separately from others, using personal items (e.g., utensils and towels) exclusively (i.e., not sharing them), and wearing a mask when near household members. The 10-day quarantine was extended for any contacts who had early symptoms (e.g., headache or myalgias). If Toronto Public Health could not reach a close contact until more than 10 days after his or her last exposure, then the contact was assessed for SARS-like illness.

In hospitals in which SARS was transmitted to multiple staff members and patients, it was difficult to identify all possible exposures within the 10-day incubation period. Therefore, all persons in a hospital during a defined period were considered contacts and were quarantined for the 10 days immediately after their last day in the hospital. "Work quarantine" was established to prevent a shortage of essential health care staff. Members of the hospital and paramedic staff under work quar-



**Figure 1. Onset of SARS in Residents of Toronto in Relation to the Implementation of Control Measures.**

The onset of the last case of SARS in Toronto that was not travel-related was on June 8, 2003. The World Health Organization designated Toronto as a region not affected by SARS 20 days after a case with an onset on June 12, 2003, outside of Toronto. Community penetration quantifies the extent of transmission beyond the hospital or travel-related setting, and the levels are as follows: zero degree (cases that were related to travel or patients who were exposed in the hospital), first degree (cases among household contacts of persons with zero-degree cases; cases among contacts of persons with first-degree cases in the same household were also considered first-degree cases), second degree (cases among contacts of persons with zero-degree or first-degree cases outside households of persons with zero-degree cases [e.g., work and school contacts]), and third degree (cases among contacts of persons with second-degree cases). ICU denotes intensive care unit.

**Table 1. Numerical Overview of the SARS Outbreak in Toronto.**

Variable	No. (%)
Cases of SARS	358 (100.0)
Among Toronto residents	225 (62.8)
Among non-Toronto residents in municipalities adjoining Toronto	133 (37.2)
Potential SARS cases investigated in Toronto	2,132 (100.0)
Did not meet case definition of SARS	1,907 (89.4)
Met the definition of probable or suspected case of SARS	225 (10.6)
Classified as probable SARS	201 (89.3)
Classified as suspect SARS	24 (10.6)
Patients in Toronto who met the case definition of SARS	225 (100.0)
Serologic tests performed during the convalescent phase	129 (57.3)
Positive	124 (96.1)
Negative	5 (3.9)
Required care in the intensive care unit	55 (24.4)
Required intubation	40 (72.7)
Did not require intubation	15 (27.3)
Survived	187 (83.1)
Died*	38 (16.9)
Contacts of patients in Toronto who were identified as requiring quarantine	23,103 (100.0)
Complied with the quarantine	13,291 (57.5)
Reached after the required quarantine period	8,058 (34.9)
Could not be reached during the SARS outbreak	1,754 (7.6)
Site of exposure	
Hospital	16,149 (69.9)
Work or school	2,148 (9.3)
Doctor's office	2,150 (9.3)
Setting involving social ties or extended family	924 (4.0)
Household of a patient	554 (2.4)
Other settings	1,178 (5.1)
Calls to the Toronto Public Health hotline†	316,615 (100.0)
Calls in which the "listen to recorded information" option was selected	183,439 (57.9)
Calls in which the "speak to a staff person" option was selected but that were not handled by a staff person	104,852 (33.1)
Calls handled by a SARS hotline staff person	28,324 (8.9)

\* Thirty-six patients with SARS died within 8 weeks after the onset of the illness; one died 15 weeks and one 18 weeks after the onset, from complications of SARS.

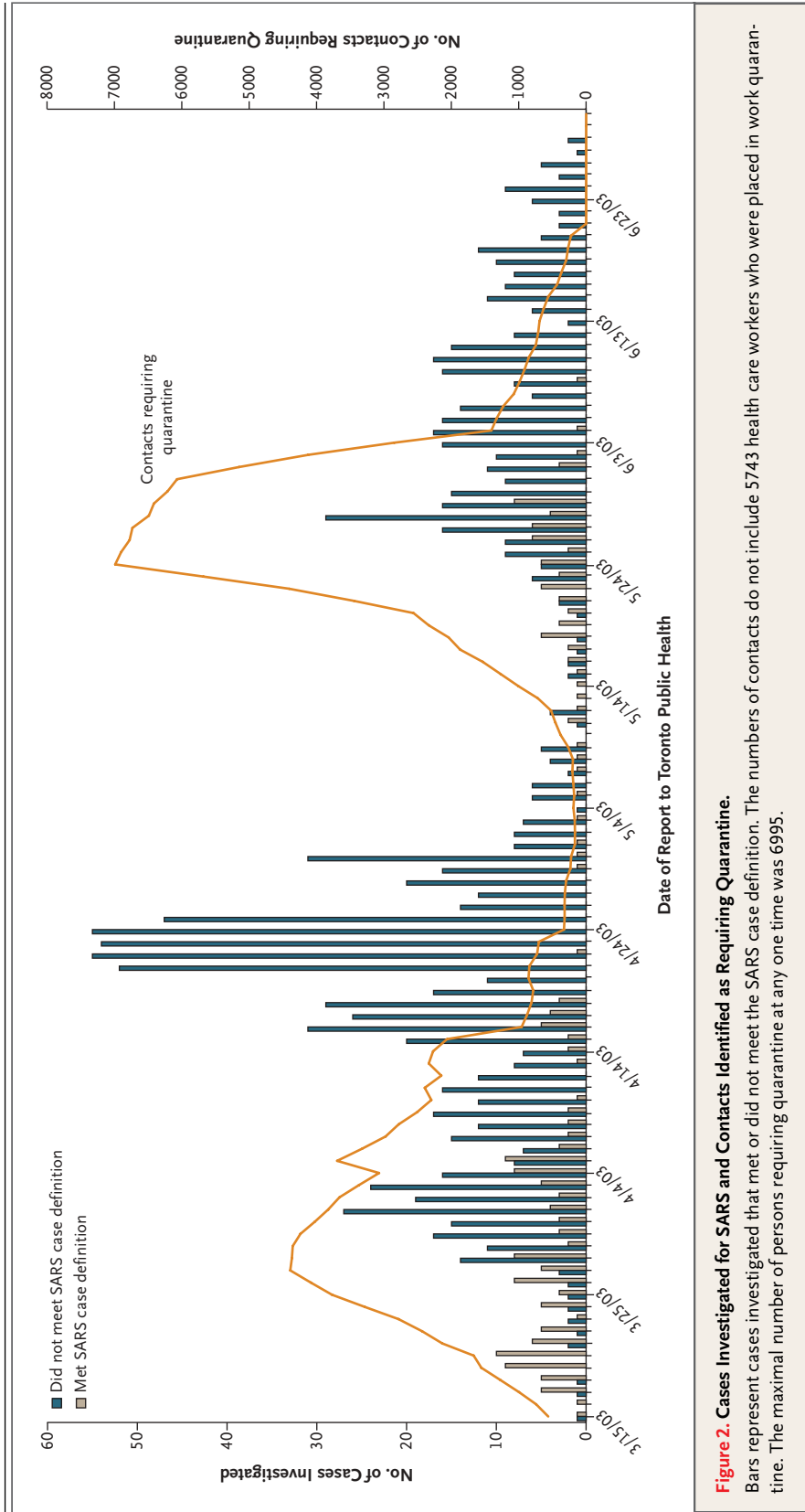
† The maximal number of hotline calls to Toronto Public Health in one day was 41,789. The number of calls handled by a staff person ranged from 214 to 1471 in one day. The number of calls that could be handled was limited by the number of available staff persons and the complexity and duration of each call.

antine were permitted to go to work, where they followed the infection-control precautions required for all health care staff members. When they were not at work, they were quarantined at home.

**STATISTICAL ANALYSIS**

Fisher's exact test and Student's t-test (performed with the use of SPSS software, version 10) were

used to compare categorical and continuous variables for demographic characteristics and risk factors. For patients with one distinct exposure, the incubation period was calculated as the length of time between exposure and the onset of symptoms. The incubation period could not be calculated for patients with multiple exposures. Community spread was described in terms of community



**Figure 2. Cases Investigated for SARS and Contacts Identified as Requiring Quarantine.**

Bars represent cases investigated that met or did not meet the SARS case definition. The numbers of contacts do not include 5743 health care workers who were placed in work quarantine. The maximal number of persons requiring quarantine at any one time was 6995.

**Table 2. Proportion of SARS Cases According to Exposure.**

Risk Factor*	Phase 1 (N=148)	Phase 2 (N=77)	Total (N=225)	P Value†	Odds Ratio (95% CI)‡
	<i>no. of patients (%)</i>				
<b>Setting of exposure</b>					
<b>Hospital</b>					
Ward	25 (16.9)	68 (88.3)	93 (41.3)	<0.001	37.2 (16.4–84.2)
Emergency room	22 (14.9)	0	22 (9.8)	<0.001	—
Other	14 (9.5)	1 (1.3)	15 (6.7)	0.02	0.13 (0.0–1.0)
Intensive care unit	13 (8.8)	0	13 (5.8)	0.005	—
Critical care unit	9 (6.1)	0	9 (4.0)	0.03	—
Long-term care facility	4 (2.7)	0	4 (1.8)	0.30	0.0 (0.0–2.9)
Ambulance	1 (<1.0)	1 (1.3)	2 (<1.0)	1.0	1.9 (0.1–31.4)
<b>Nonhospital</b>					
Household	40 (27.0)	7 (9.1)	47 (20.9)	0.002	0.3 (0.1–0.6)
Private gathering	10 (6.8)	0	10 (4.4)	0.02	—
Clinic	5 (3.4)	0	5 (2.2)	0.17	—
Travel§	4 (2.7)	0	4 (1.8)	0.30	—
Workplace	1 (<1.0)	0	1 (<1.0)	1.0	—
<b>Role during exposure¶</b>					
<b>Hospital</b>					
Nurse	27 (18.2)	17 (22.1)	44 (19.6)	0.49	1.3 (0.6–2.5)
Patient	24 (16.2)	25 (32.5)	49 (21.8)	0.007	2.5 (1.3–4.4)
Visitor of a patient	13 (8.8)	12 (15.6)	25 (11.1)	0.18	1.9 (0.8–4.4)
Physician	11 (7.4)	4 (5.2)	15 (6.7)	0.59	0.7 (0.2–2.2)
Other member of hospital staff	10 (6.8)	8 (10.4)	18 (8.0)	0.44	1.6 (0.6–4.2)
Emergency medical service staff member	1 (<1.0)	1 (1.3)	2 (<1.0)	1.0	1.9 (0.1–31.4)
Ancillary patient care staff member	6 (4.1)	3 (3.9)	9 (4.0)	1.0	1.0 (0.2–3.9)
<b>Nonhospital</b>					
Household member	32 (21.6)	7 (9.1)	39 (17.3)	0.02	0.4 (0.1–0.9)
Community contact	11 (7.4)	0	11 (4.9)	0.02	—
Nonhousehold close contact	6 (4.1)	0	6 (2.7)	0.10	—
Traveler§	4 (2.7)	0	4 (1.8)	0.30	—
Household visitor	2 (1.4)	0	2 (<1.0)	0.55	—
Other	1 (<1.0)	0	1 (<1.0)	1.0	—

\* The risk factors listed were those associated with the greatest degree of exposure according to the definition of close contact (people who cared for, lived with, or had face-to-face contact [within 1 m] with a person with SARS or direct contact with respiratory secretions or body fluids of a person with SARS).

† Fisher's exact test (two-tailed) was used to determine statistical significance. A two-by-two contingency-table analysis was used to compare risk factors in phase 1 and phase 2.

‡ Odds ratios are for phase 2 as compared with phase 1. CI denotes confidence interval.

§ Exposure occurred in a country designated by the WHO as having ongoing transmission of SARS.

¶ The role during exposure indicates a patient's occupation or role during exposure rather than his or her occupation or role in general. For example, a nurse who was exposed at a social gathering was considered a participant in a private event rather than a nurse. All but three new travel-related cases could be linked back to the index case.

penetration, a measure of the extent of transmission beyond the hospital or travel-related setting. We defined levels of community penetration as zero degree (cases that were related to travel or patients who were exposed in the hospital), first degree (cases among household contacts of persons with zero-degree cases; cases among contacts of persons with first-degree cases among the same household were also considered first-degree cases), second degree (cases among contacts of persons with zero-degree or first-degree cases outside households of persons with zero-degree cases [e.g., work and school contacts]), and third degree (cases among contacts of persons with second-degree cases).

## RESULTS

### POTENTIAL, SUSPECT, AND PROBABLE SARS CASES

Table 1 summarizes the number of cases that we investigated for SARS. Of 2132 persons identified as potentially having SARS, 1907 did not meet the case definition of SARS (Fig. 2). We received the results of serologic tests on samples from 129 (57.3 percent) of the 225 patients with probable or suspect cases of SARS during the convalescent phase. Of these persons, 124 (96.1 percent) had positive tests; 5 had negative tests; and 96 refused testing, died, or could not be contacted.

A subgroup of 59 patients was identified as having a single point of exposure to SARS. In this subgroup, the average incubation period was 4.7 days (range, 1 to 12). Only one patient had an incuba-

tion period greater than 10 days (1.7 percent; 95 percent confidence interval, 0.0 to 5.0), becoming ill on day 12 after exposure. The 20-day attack rate among contacts identified as requiring isolation or quarantine was 1.0 percent (95 percent confidence interval, 0.8 to 1.1).

Of the 225 patients with SARS among Toronto residents, 187 patients recovered (83.1 percent) and 38 (16.9 percent) died from SARS (Table 1). The average age of the patients with SARS was 49 years (range, 5 months to 99 years). Eleven patients (4.9 percent) were less than 18 years of age. Of those who died, 21 (55.3 percent) had been exposed to SARS as hospital inpatients; the average age of persons who died was 71 years (range, 38 to 99).

### EVOLUTION OF THE OUTBREAK IN RELATION TO CONTROL MEASURES

Figure 1 plots the SARS epidemic according to the onset of symptoms in relation to the implementation of control measures. Phase 1 of the outbreak began with the index patient returning to Toronto from a visit to Hong Kong. She died at home, of unrecognized SARS, on March 5, 2003. A son of the index patient was admitted to Hospital A with severe respiratory illness on March 7 and died on March 13. Within 24 hours, four other ill family members were put into isolation in four other hospitals. Staff illness in Hospital A was first recognized on March 21, and the hospital was closed on March 25. Further spread in Hospital A and related households is described elsewhere.<sup>17</sup> The transfer of inpatients with incubating or unrecognized SARS between institutions resulted in nosocomial transmission in additional sites; health care workers who were employed at more than one site also transmitted SARS. The mean ( $\pm$ SD) time between the onset of symptoms and the reporting of a case to Toronto Public Health was  $3.9\pm 3.2$  days. Phase 1 also included a cluster of 33 cases related to a close-knit religious group. When the link to the religious group was recognized, all 500 members were quarantined and evaluated; 3 of the 33 cases in this cluster were identified in the initial assessment for symptoms.

On April 10, 16 days after hospital infection-control measures were implemented provincially, the daily number of new cases declined (Fig. 1). A surge of cases followed within a group of hospital staff members whose exposures were related to prolonged resuscitation and intubation in a patient who was critically ill with SARS in Hospital F. This

**Table 3. Proportion of SARS Cases According to the Degree of Community Penetration.**

Community Penetration	Phase 1 (N=148)	Phase 2 (N=77)	Total (N=225)	P Value*
0 degree†	92 (62.2)	70 (90.9)	162 (72.0)	<0.001
1st degree	37 (25.0)	7 (9.1)	44 (19.6)	<0.001
2nd degree	16 (10.8)	0	16 (7.1)	0.003
3rd degree	3 (2.0)	0	3 (1.3)	0.3

\* A two-by-two contingency-table analysis was used to compare community penetration in phase 1 and phase 2. Fisher's exact test (two-tailed) was used to determine statistical significance.  $P < 0.001$  for the difference in combined second-degree and third-degree penetration between phase 1 and phase 2.

† There can be no third-degree penetration without second-degree penetration. † In phase 1, there were three travel-related zero-degree cases in addition to the index travel-related case. The rest of the patients with zero-degree cases were exposed in the hospital.

resurgence led to the refinement of infection-control measures for high-risk, aerosol-generating procedures.<sup>18</sup> After this surge of cases, no new cases were recognized for a period of 20 days, and the outbreak was believed to be over.

Phase 2 was recognized after a cluster of patients with a SARS-like illness in a rehabilitation hospital (Hospital I) was traced back to Hospital H.<sup>19</sup> Active screening of patients and a chart review in Hospital H revealed previously unrecognized cases of SARS in patients and health care workers. Changes in the risk factors for SARS between phases 1 and 2 are shown in Table 2.

#### COMMUNITY SPREAD

Community spread as reflected by the degree of community penetration is summarized in Table 3. Transmission of SARS occurred in 11 (58 percent) of Toronto's acute care hospitals. In addition to the index case, three cases of SARS (1.3 percent) were related to travel. With the exception of the index case, early identification and isolation prevented further spread of the virus from these travel-related cases. The proportion of cases with second-degree and third-degree penetration in phase 1 was significantly greater than in phase 2 (12.8 percent vs. 0 percent,  $P < 0.001$ ).

In phase 1, instances of second-degree community penetration included three exposures to SARS in doctors' offices, one prolonged exposure to a friend with SARS outside of a household, and one exposure to a close workmate. The cluster of 33 cases related to members of the religious group included second-degree and third-degree penetration. The 33 patients included 14 members of an extended family whose exposure was traced back to 3 family members who were exposed in the emergency room of Hospital A (zero-degree penetration). Eleven patients were exposed in social situations, such as a religious retreat, and three in a doctor's office (second-degree penetration); SARS also developed in three members of these patients' households (third-degree penetration). Six patients in this cluster were not residents of Toronto, including one who was visiting from the United States.

#### QUARANTINE AND CALLS TO THE HOTLINE

During the outbreak, 23,103 contacts were identified as requiring quarantine (Fig. 2). Of those in quarantine, 27 (0.1 percent) were issued a legally

enforceable quarantine order owing to initial non-compliance. A breakdown of 316,615 calls to the Toronto Public Health SARS hotline is given in Table 1. The most common reason for calling was to discuss potential exposures.

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### DISCUSSION

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In Toronto, the SARS outbreak took a serious toll on patients and hospital workers, as well as on their friends and families. This analysis of data from Toronto Public Health provides insights into the spread of a new communicable disease in relation to control measures.

SARS in Toronto was primarily a nosocomial illness, largely restricted to persons who were exposed in affected hospitals and their household contacts. The few cases of second-degree and third-degree community penetration mostly involved persons with very close social ties. Despite the extremely limited community spread, the WHO and the Centers for Disease Control and Prevention identified Toronto as a SARS-affected area. With a predominantly nosocomial illness such as SARS, information about community penetration, as described here, may be useful in defining SARS-affected areas.

Enhanced infection-control measures and the identification and follow-up of contacts resulted in a sharp drop in the transmission of SARS in Toronto hospital and outpatient settings. Our analysis showed two resurgences in the number of cases in persons with distinct risk factors that led to specific changes in outbreak-control practices. The first, in phase 1, was related to the intensive care unit in Hospital F and led to enhanced infection-control procedures; subsequently, there was no further transmission in intensive care units.<sup>18</sup> The second resurgence occurred in phase 2 among hospitalized patients, after enhanced hospital and community infection-control measures had been relaxed when the outbreak was initially believed over. Reinstitution of full control measures that were developed in phase 1 resulted in an absence of second-degree and third-degree community penetration in phase 2; in reduced numbers of intensive care unit, emergency room, outpatient, and household-related cases; and in an increased proportion of hospital-ward cases. Active surveillance of hospital-ward patients in phase 2 brought an end to the outbreak.

Control efforts succeeded because of intensive

follow-up of contacts of the patients, a 10-day quarantine period, and the search for cases among contacts who were reached more than 10 days after their last exposure. SARS may be a seasonal illness, as are other respiratory viruses; the coming of summer may have helped to end the outbreak. There was considerable pressure to lengthen the quarantine period to 14 days. Our data did not support a quarantine period longer than 10 days, and we instead opted for daily follow-up of symptoms by Toronto Public Health staff or self-monitoring after discharge from quarantine. The average incubation period of 4.7 days in Toronto is consistent with data from Hong Kong.<sup>20</sup> SARS developed on day 12 in one patient who, while self-monitoring, reported to Toronto Public Health; no transmission resulted. Identification of early symptoms of SARS is much more difficult in persons who are exposed as inpatients. A longer period of postexposure isolation and monitoring may be appropriate for this medically complex group.

The number of persons evaluated for SARS, the number requiring quarantine, and the number of calls to the public health hotline reflect a much greater volume of work and burden to the community than might be suggested by case counts alone. In hindsight, overrecognition of contacts, especially in two hospitalwide quarantine efforts, may have resulted in an overestimate of the number of persons requiring quarantine. The Toronto SARS outbreak came at the tail end of the influenza season, possibly increasing the number of potential SARS cases, calls to the hotline, and persons requiring quarantine. Prevalent community respiratory infections can be expected to affect the availability of resources that are needed to manage outbreaks of new SARS-like diseases.

We did not perform serologic tests during the convalescent phase for all the potential SARS cases that we investigated. As compared with test results, the definitions of probable and suspect SARS cases had a positive predictive value of 96.1 percent. A sensitivity analysis showed no change in the tests of significance presented here, with misclassification of up to 8 percent of cases. The absence of clusters of severe SARS-like illness in persons who had no identifiable exposure during the outbreak and five months later suggests that our definitions

were sensitive for infectious illness and that few, if any, such cases were missed.

Only Toronto Public Health data were available for this analysis. We excluded data from adjacent municipalities, which may have had different methods of data collection and interpretation. As discussed in a recent report from the Canadian government, leadership and coordination in the collection, management, and sharing of data are critical, as are strong mechanisms for linking epidemiologic and clinical information to laboratory data.<sup>21</sup>

Our data show that SARS spreads when it is not recognized. Once it was recognized, the infection-control measures that were instituted worked well. However, within hospitals, severe restrictions due to SARS resulted in delays in treatments for cancer and surgeries, and the continuous, universal use of N95 respirators and other forms of personal protection was stressful for health care workers. Our experience suggests that the spread of SARS-CoV by means of respiratory droplets can be controlled in many settings with less restrictive measures (e.g., the use of surgical masks in quarantine). Studies examining the costs and effectiveness of various control measures are under way. During an outbreak, health care workers must have a high index of suspicion for SARS in persons who present with acute respiratory symptoms and in patients with chronic respiratory illness, especially those in the hospital setting in whom fever develops. This experience underlines the need for public health organizations to become more involved in hospital surveillance and in the control of nosocomial infections. Surveillance for unusual infections in travelers and adequate public health surge capacity are critical in the light of threats of emerging diseases. Data from Toronto show that emerging infectious diseases such as SARS can be controlled in a major North American urban center if there is a strong, responsive, and active public health infrastructure.

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