

SARS assessment clinic: a rapid response to an infectious outbreak

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ABSTRACT

The Toronto SARS outbreak began in February 2003 and lasted more than 16 weeks. The city and its health care system faced enormous challenges in responding to this new infectious disease, learning about its transmission, diagnosis and treatment, in containing its spread and in coping with its socioeconomic impact. As the site of a significant cluster of cases in the second wave of the outbreak, North York General Hospital (NYGH) quickly adapted many components of its operations, focusing on the fight against SARS. In order to assess potential SARS cases in a safe, efficient and effective manner, NYGH established a SARS assessment clinic. We describe the design features, construction, layout and operation of this clinic. This type of clinic can be rapidly deployed and may be of great value during future infectious outbreaks, including pandemic influenza.

Key words: severe acute respiratory syndrome; SARS; outbreak; assessment clinic

RÉSUMÉ

L'écllosion de SRAS à Toronto a commencé en février 2003 et a duré plus de 16 semaines. La ville et son système de soins de santé ont eu d'énormes défis à relever pour réagir à cette nouvelle maladie infectieuse, apprendre son mode de transmission, son diagnostic et son traitement, en contenir la propagation et faire face à ses répercussions socioéconomiques. Site d'une grappe importante de cas au cours de la deuxième vague de l'écllosion, l'Hôpital général North York (HGNY) a adapté rapidement de nombreux éléments de ses activités pour concentrer son attention sur la lutte contre le SRAS. Afin d'évaluer des cas possibles de SRAS de façon sécuritaire, efficiente et efficace, le HGNY a établi une clinique d'évaluation du SRAS. Nous décrivons les caractéristiques du concept, la disposition et le fonctionnement de cette clinique. Une clinique de ce type peut être déployée rapidement et pourrait une grande valeur au cours de futures éclosions de maladies infectieuses, y compris une pandémie de grippe.

Introduction

Severe acute respiratory syndrome (SARS) is a new corona-virus-induced infectious disease that originated in Guangdong Province, China, in November 2002.¹ The disease spread globally, with Toronto recording its first case

on Feb. 23, 2003.² The subsequent Greater Toronto Area (GTA) outbreak evolved in 2 phases over a 4-month period and resulted in 247 probable cases and 43 deaths.³ The first cluster of cases stemmed from contacts with a family member of the index case in a northeast Toronto emergency department (ED). The second cluster originated

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from nosocomial transmission of unrecognized SARS on a surgical ward at North York General Hospital (NYGH) after strict SARS control measures were relaxed provincially.^{4,5} The epidemiologic link to the first cluster of cases in Toronto was never identified.⁶ Toronto's last SARS case was detected on June 12, 2003.

With the emergence of the second phase of the Toronto outbreak, the Ontario Ministry of Health requested the establishment of 3 SARS assessment clinics (SACs) strategically located across the GTA, with 1 located at NYGH. The challenge was to quickly design and operate a facility capable of rapidly assessing large numbers of potential SARS patients while assuring the safety of the personnel and other patients. This task was completed by members of the NYGH ED with support from the broader hospital team, particularly its infection control experts and building services department. This description of the design, construction and operation of an SAC may be helpful to other organizations as they prepare for future infectious outbreaks.

Design and layout

The SAC was constructed in the ED ambulance bay, a

1782-square-foot (165.5-m²) brick structure with 2 large ambulance bay doors at each end. Supplemental fluorescent lighting was added, and a ceiling ventilation system was installed, with 8-inch (20.3-cm) ducts feeding into a main 18-inch (45.7-cm) duct that vented to the existing exhaust system on the ambulance bay roof. This system provided negative pressure ventilation through ceiling vents for each SAC examination room. Daily smoke tests confirmed at least 6 air exchanges per hour, as recommended by Health Canada.^{7,8}

The layout of the SAC is illustrated in Figure 1. Eight individual examination rooms, each 8-ft × 10-ft (2.4-m × 3.0-m), were framed with conduit pipe and covered with industrial plastic on all 4 walls and the ceiling (Fig. 2). The plastic was checked to confirm that there was no observable degradation when it was washed repeatedly with the antimicrobial cleanser Virox® (Virox Technologies Inc., Mississauga, Ont.) The bottoms of the plastic walls were affixed to the floor with 2-inch × 1-inch (5.1-cm × 2.5-cm) boards. Cloth curtains were hung on each of the walls for privacy and covered with a second layer of plastic to allow for cleaning. An entrance was cut in the front wall of each room and then covered with a sliding curtain (Fig. 3).

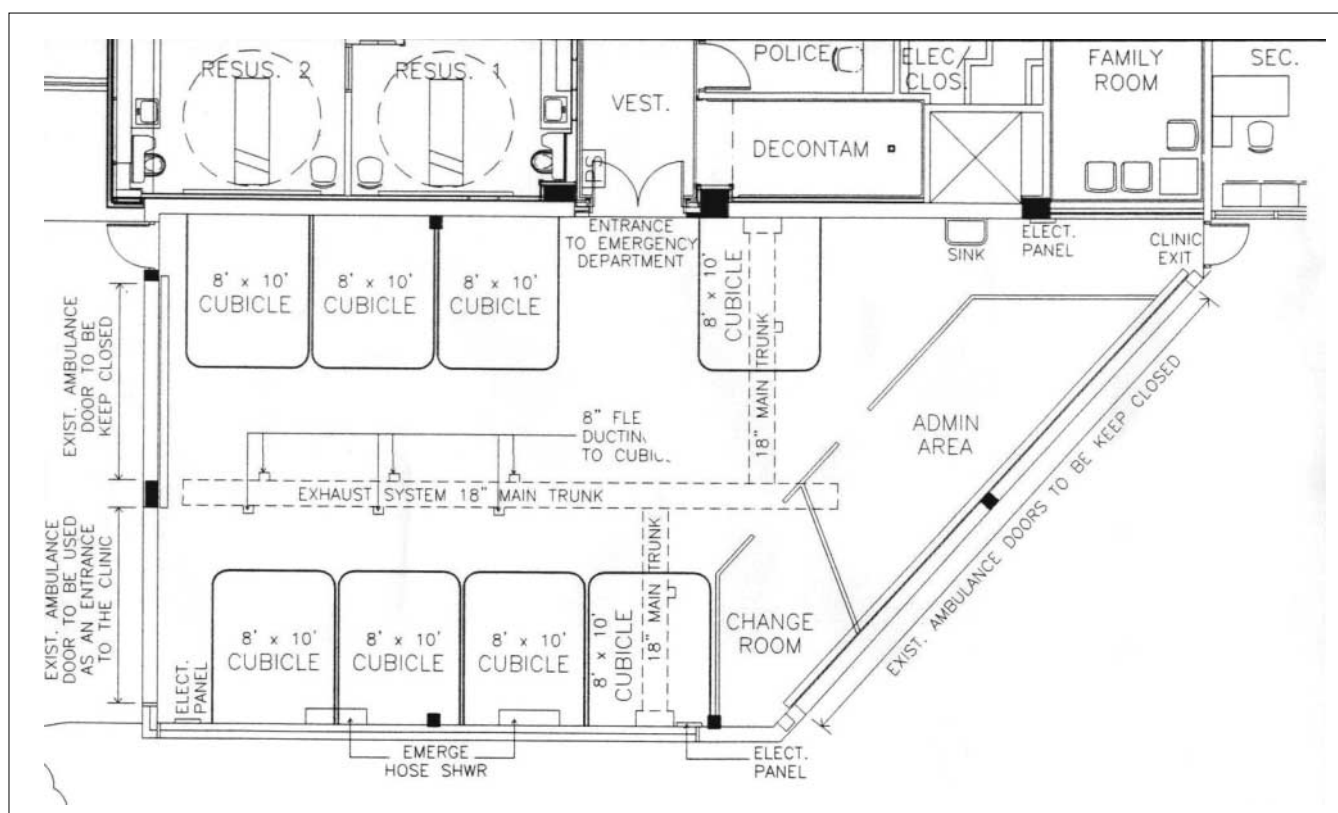


Fig. 1. SARS assessment clinic layout. See "Design and layout" in Methods for metric conversion of measurements. Resus. = resuscitation room (in the ED); Vest. = vestibule; Police = prehospital personnel office; Elec/Clos = electrical closet; Sec. = security office; Shwr = shower; Elect. = electricity; Admin. = administration; Decontam = decontamination; Cubicle = examination room.

Each examination room contained a small table, laundry bin and antimicrobial cleansing solution. Diagnostic equipment included a thermometer, stethoscope, blood pressure cuff and tongue depressors. Hard plastic chairs were used in 6 of the rooms because most patients were well enough to sit through their stay and the chairs were easy to clean. Stretchers were placed in 2 of the rooms for sicker patients.

A plastic enclosure was created for clerical staff and equipped with computers, telephones and fax machines. Adjacent to this was a change room containing personal protective equipment (PPE). The central common area had work areas for the physicians and nurses as well as supply carts. A single sink was placed in the common area, using existing plumbing and drainage.

The decontamination room immediately inside the ED's ambulance entrance was retrofitted as an x-ray room by shielding its walls with lead. A portable x-ray machine was placed in this room for the duration of SAC operation. Cassette films were digitalized with a computed radiography (CR)-reader, enabling emergency physicians to view images at a PACS (picture archiving and communications systems) station.

A 20-ft \times 40-ft (6.1-m \times 12.2-m) tent was placed at one end of the ambulance bay. This functioned as the entrance to the facility and housed a triage desk, waiting area and patient registration area. Hard plastic chairs were placed 6.6 feet (2 metres) apart in the waiting area. The registration area consisted of a plastic enclosure containing 2 computer workstations and office supplies. A portable 2-washroom unit was placed outside the SAC entrance for patient use. A second tent, 20-ft \times 20-ft (6.1-m \times 6.1-m), was placed at the opposite end of the facility as a place for discharged patients to wait for instructions.

The SAC was created in just over a week, and the struc-

tural components have been put into storage so that the facility could be rebuilt in 2 days.

SARS assessment clinic operation

Policies and procedures included detailed processes for SAC patient flow, proper use of PPE (Appendix 1), admission and transfer of admitted SARS patients and decontamination of the SAC rooms and equipment after each use. These were consistent with Health Canada's SARS Infection Control Guidelines.^{7,8} Prior to opening the SAC, infectious diseases and infection control experts conducted reviews of the clinic to ensure safety for staff and patients. All staff were provided with a detailed orientation session prior to working in the clinic.

The SAC operated from 9 am to 8 pm, 7 days a week. Emergency physicians and nurses experienced in assessing SARS patients staffed the clinic. Infectious diseases consultants were readily available. All staff followed droplet and contact precautions, and adhered to protocols for donning and removing PPE (Appendix 1).

All health care workers used N95 respirator masks for respiratory protection. The N95 respirator mask is fluid-resistant and disposable, and has a filter efficiency level of at least 95% against oil-free particulate aerosols with particle size of 0.3 microns or larger.⁹

An SAC patient record was designed for clinical documentation by physicians and nurses. This included sections for the triage assessment, SARS symptoms, epidemiological links, physical findings, investigations, diagnosis and disposition. Efficient and consistent charting was facilitated by use of check boxes where possible. The design of the patient record supported the protocol-driven operation of the SAC.

The SAC layout facilitated one-way patient flow. Secu-



Fig. 2. Construction of examination rooms.



Fig. 3. Examination rooms with plastic covered curtains. Entrances were covered with sliding curtains.

rity personnel provided a surgical mask and hand sanitizer to each patient on entry to the clinic. Triage nurses measured tympanic temperatures and took brief histories, using this information to stratify patients as high or low risk. High-risk patients were defined as those with epidemiological links and symptoms or with fever and respiratory symptoms. High-risk patients were taken directly into an examination room, and a red sticker was placed on their chart.

Patients passed their health insurance cards through a slot in the plastic enclosure to the registration staff, who handled the cards with gloved hands, changing gloves afterward. Following registration, patients were escorted to an examination room (low-risk patients could be held briefly in the waiting room when no exam rooms were available). Staff members opened curtains when patients entered and exited their examination rooms, and patients were asked not to touch the walls or curtains within the clinic space.

Physicians performed the first clinical assessment. No items (e.g., charts, pens) were allowed into the examination room. Nursing assessment was completed after physician assessment to limit the number of entries into the examination room. If the patient required investigations, the nurse would enter once, measure vital signs and perform venipuncture. If the physician determined that the patient could be discharged without investigations, the nurse provided discharge instructions after ensuring that the patient's vital signs were normal. Abnormal vital signs prompted a review of the disposition. Immediately after patient assessment, all health care workers underwent meticulous decontamination (Appendix 1).

Patients were discharged with pre-printed instructions, including information about quarantine and isolation. An on-site public health nurse reviewed all charts and traced contacts when indicated.

The SAC opened June 4, 2003, and closed on July 11, 2003, after 211 patient visits, considerably fewer than expected. The patient population consisted of patients with respiratory symptoms (with or without fever), as well as asymptomatic patients with concerns about possible contacts. During the first 13 days of clinic operation, 94 distinct patients made a total of 104 visits. Of these, 16 (17%) were admitted under the categories of "person under investigation," suspected SARS or probable SARS. Based on the decline of the epidemic, there were no further admissions through the clinic after day 13, but it remained open for an additional 25 days in case of a third wave.

Discussion

The emergence of SARS created many challenges for gov-

ernment and public health officials, hospital administrators and health care workers. There was a great deal to learn about how to manage this new infectious disease and an urgent need to do so quickly. SARS assessment clinics were opened in Toronto, Hong Kong and other communities with SARS outbreaks.¹⁰ The purpose of the SAC was to screen people at risk, those with SARS-like symptoms, and those who were concerned that they may have SARS. The goal was to divert SARS screening away from EDs, physicians' offices and community clinics, and to focus this activity in facilities prepared to do SARS assessments in an efficient and safe manner.

The SARS coronavirus is transmitted by direct patient contact or contact with large respiratory droplets within close vicinity of an infected person.¹¹ In the Toronto outbreak most transmission occurred in hospitals and other health care facilities when precautions were not taken.¹² Health care workers were at greatest risk, accounting for over 40% of SARS infections in Toronto, and several family physicians contracted the disease from their patients.⁶

Smallpox outbreaks during the last century provided valuable lessons in planning a response to SARS. Like SARS, smallpox virus is transmitted by droplets and direct contact. Most smallpox outbreaks occurred in hospitals, with over 60% of those infected being health care workers, patients and their visitors. A key strategy for control and eradication of smallpox was the implementation of smallpox hospitals and free-standing smallpox assessment clinics.¹³

Our first critical decision was determining what type of structure to build for the SAC. We considered a large tent or portable building in a hospital parking lot, but the ambulance bay was preferable because it is less susceptible to environmental factors (particularly adverse weather conditions), because it has pre-existing heating, lighting, plumbing and water drainage, and because of its proximity to a suitable room for radiography.

SARS diagnosis

SARS presents a significant diagnostic challenge because its symptoms are similar to those of more common respiratory infections. Because of poor sensitivity, the World Health Organization criteria for identifying patients with SARS (Appendix 2¹⁴) were of limited value for screening and early diagnosis. In 1 Hong Kong study of 556 patients attending a SAC, only 25 of 97 patients with confirmed SARS met the WHO criteria for a suspect case at the time of presentation, for a sensitivity of 26%.¹⁵ In another study, the WHO criteria were only 42% sensitive and 86% specific, substantially less accurate than the judgement of experienced clinicians.¹⁴ The clinicians working in our SAC

were emergency physicians and nurses who had already gained considerable experience in diagnosing and managing SARS patients. Most patients seen in our SAC were in the early stages of their symptoms. We used a low threshold for ordering a standardized set of investigations on symptomatic patients. A complete blood count and differential, lactate dehydrogenase (LDH) and creatine kinase (CK) were used as screening tests. Patients with SARS frequently had elevated LDH and CK and decreased white blood cell count and lymphocytes.¹⁴ Patients with fever or respiratory symptoms underwent posterior–anterior chest radiography. Patients who had equivocal chest radiographs and those who had an epidemiological link and persistent fever underwent high-resolution CT. At-risk patients who were not admitted (e.g., possible contact, fever and normal chest radiograph) were discharged home on strict isolation and followed up in 48 hours with a repeat chest radiograph.

The SAC was successful from several perspectives. Family physicians in the community considered it a highly valuable resource (David W. White, Chief, Family and Community Medicine, NYGH, Toronto: personal communication, 2005). As far as we are aware, no missed cases of SARS went through the SAC and there were no transmissions to staff or patients at the facility. Toronto's Public Health Department studied every SARS case in Toronto and traced all contacts. Toronto Public Health had a team on site at NYGH who communicated regularly with the directors of the SAC. It is highly likely that any SAC patient who was subsequently diagnosed with SARS would have come to our attention.

Limitations

An important limitation is that the clinic was underutilized; therefore we cannot conclude that it would have been as safe or effective with a greater patient volume, like that expected with a more prolonged infectious outbreak. The likely explanation for the small numbers seen at the SAC is that, by the time it opened, the second wave of the outbreak had peaked. Because of this unfortunate timing, more cases were managed in the ED during the 2 weeks prior to the SAC opening than were managed in the SAC while it was operational. Fortunately, none of the health care workers or support staff from the NYGH ED or SAC were infected during the outbreaks.

Conclusions

The 2003 Toronto SARS outbreak was a crisis for the city and its health care system. It has served as a reminder that new infectious diseases will continue to emerge. SARS as-

essment clinics were created as a strategy to assess patients for SARS in a safe, efficient and effective manner. Careful facility design and protocol development are key success factors. Similar focused assessment clinics may be a valuable strategy in dealing with future outbreaks of new or old pathogens.

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Competing interests: None declared.

References

1. Ksiazek TG, Erdman D, Goldsmith CS, Zaki SR, Peret T, Emery S, et al. A novel coronavirus associated with severe acute respiratory syndrome. *N Engl J Med* 2003;348:1953-66.
2. Poutanen SM, Low DE, Henry B, Finkelstein S, Rose D, Green K, et al. Identification of severe acute respiratory syndrome in Canada. *N Engl J Med* 2003;348:1995-2005.
3. Public Health Agency of Canada. SARS situation update and continuing national surveillance. Sept 5, 2003. Available at: www.hc-sc.gc.ca/pphb-dgsp/sars-sras/cn-cc/numbers.html (accessed 2005 Mar 22).
4. Update: severe acute respiratory syndrome — Toronto, Canada, 2003. *MMWR Morb Mortal Wkly Rep* 2003;52(23):547-50.
5. Wallington T, Berger L, Henry B, Shahin R, Yaffe B, Mederski B, et al; SARS Investigation Team. Update: severe acute respiratory syndrome — Toronto, 2003 [published erratum appears in *Can Commun Dis Rep* 2003;29(14):128]. *Can Commun Dis Rep* 2003;29(13):113-7.
6. Public Health Agency of Canada. Learning from SARS: renewal of public health in Canada. A report of the National Advisory Committee on SARS and Public Health, October 2003. Available at: www.phac-aspc.gc.ca/publicat/sars-sras/naylor/index.html (updated 2003 Nov 8; accessed 2005 Mar 22).
7. Health Canada. Infection control guidance for health care workers in health care facilities and other institutional settings: severe acute respiratory syndrome (SARS). Revised June 3, 2003. Available at: www.hc-sc.gc.ca/pphb-dgsp/sars-sras/pdf/sars-factsheetinstitutions06-03-03_e.pdf (accessed 2005 Mar 22).
8. Health Canada. Infection control guidance for health care workers in outpatient settings: severe acute respiratory syndrome (SARS). Revised May 27, 2003. Available at: www.phac-aspc.gc.ca/sars-sras/pdf/sars-ic-outpatient-05-27.pdf (accessed 2005 Mar 22).
9. Public Health Agency of Canada. Infection control guidance for respirators (masks) worn by health care workers — Frequently asked questions: severe acute respiratory syndrome (SARS). Revised June 5, 2003. Available at: www.hc-sc.gc.ca/pphb-dgsp/sars-sras/ic-ci/sars-respmasks_e.html (accessed 2005 Mar 22).
10. Rainer TH, Cameron PA, Smit D, Ong KL, Hung AN, Nin DC,

- 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.
11. Ofner M, Lem M, Sarwal S, Vearncombe M, Simor A. Cluster of severe acute respiratory syndrome cases among protected health care workers — Toronto, April 2003. *Can Commun Dis Rep* 2003;29(11):93-7.
 12. Low DE, McGeer A. SARS — One year later. *N Engl J Med* 2003;349:2381-2.
 13. Mack T. A different view of smallpox and vaccination. *N Engl J Med* 2003;348:461-3.
 14. Wong WN, Sek ACH, Lau RFL, Li KM, Leung JKS, Tse ML, et al. Accuracy of clinical diagnosis versus the World Health Organization case definition in the Amoy Garden SARS cohort. *Can J Emerg Med* 2003;5(6):384-91.
 15. Booth CM, Matukas LM, Tomlinson GA, Rachlis AR, Rose DB, Dwosh HA, et al. Clinical features and short term outcomes of 144 patients with SARS in the Greater Toronto Area. *JAMA* 2003;289(21):2801-9.

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Appendix 1. Droplet and contact precautions used in SARS assessment clinic: personal protective equipment

Before entering patient room:

1. Sanitize hands for 15 seconds.
2. Mask (N95)
3. Goggles
4. Face shield
5. Gown (single)
6. Gloves (double)
7. Hair cap

While in patient room:

1. If specimens required, tape a biohazard bag to the wall inside the room.
2. Provide patient care.
3. Take specimens as needed and drop into biohazard bag, taking care not to touch the bag with your gloves.
4. Slowly remove outer gloves.
5. Inner gloves are to be used for the duration of the time in the room.
6. Take biohazard bag and drop in 2nd bag held by "buddy" outside the room.

Before leaving patient room:

1. Slowly remove inner gloves and discard.
2. Sanitize hands for 15 seconds.
3. Remove face shield and discard.
4. Sanitize hands for 15 seconds.
5. Remove hair cap (from front to back) and discard.
6. Sanitize hands for 15 seconds.
7. Remove gown inside out and discard.
8. Sanitize hands for 15 seconds.
9. Open door / curtain with clean hands.
10. Exit room, close door / curtain.

After leaving patient room:

1. Sanitize hands for 15 seconds.
2. Remove N95 mask and discard.
3. Sanitize hands for 15 seconds.

Appendix 2. World Health Organization case definitions for suspected and probable SARS (as revised on May 1, 2003)

SARS is suspected in the following patients

1. A person presenting after Nov. 1, 2002* with history of:
 - high fever (>38°C)
 AND
 - cough or breathing difficulty
 AND one or more of the following exposures during the 10 days prior to onset of symptoms:
 - **close contact**[†] with a person who is a suspect or probable case of SARS;
 - history of travel to an area with recent local transmission of SARS;
 - residing in an area with recent local transmission of SARS.
2. A person with an unexplained acute respiratory illness resulting in death after Nov. 1, 2002,* but on whom no autopsy has been performed
 AND one or more of the following exposures during the 10 days prior to onset of symptoms:
 - **close contact**[†] with a person who is a suspect or probable case of SARS;
 - history of travel to an area with recent local transmission of SARS;
 - residing in an area with recent local transmission of SARS.

Probable case:

1. A suspect case with radiographic evidence of infiltrates consistent with pneumonia or respiratory distress syndrome (RDS) on chest x-ray
2. A suspect case of SARS that is positive for SARS coronavirus by one or more assays.
3. A suspect case with autopsy findings consistent with the pathology of RDS without a cause.

Source: www.who.int/csr/sars/casedefinition/en

*The surveillance period begins on Nov. 1, 2002, to capture cases of atypical pneumonia in China now recognized as SARS.

[†]Close contact: having cared for, lived with, or had direct contact with respiratory secretions or body fluids of a suspect or probable case of SARS. Table adapted from Box 1 of Wong et al.¹⁴ with permission. "Probable case" information obtained from the WHO Web site.