

ADVANCES

Effect of the SARS outbreak on visits to a community hospital emergency department

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ABSTRACT

Objectives: To examine the effect of severe acute respiratory syndrome (SARS) on visits to a community hospital emergency department (ED) during the early stage of the Toronto outbreak in 2003 and for the same period in 2004. We focused on visits for respiratory illness (SARS-like symptoms) and different age groups.

Methods: This study is a retrospective review of ED discharge diagnoses obtained from a computerized database, examining the 4-week period starting March 28 for the years 2001–2004. We obtained the discharge diagnosis, age and visit date for each ED patient during the relevant time intervals, then compared visit data from 2003 and 2004 with a baseline derived from the average number of visits during 2001 and 2002. We constructed groupings based on age and respiratory-illness symptoms.

Results: During the SARS outbreak in 2003, ED visits declined by 21% (95% confidence interval [CI], 18%–24%) over the 4-week study period. The greatest reduction was for combined infant and toddler visits (69%; 95% CI, 58%–79%); these did not recover the following year. However, during the SARS outbreak there was a large increase in the number of visits for respiratory illnesses in adults (61%; 95% CI, 46%–75%) and in teenagers (132%; 95% CI, 82%–182%).

Conclusions: During the SARS outbreak, total ED visits fell. The relative decline was most notable for infants and toddlers. By contrast, there was an increase in respiratory illness-related visits for adults and teenagers. In 2004, the year following the SARS outbreak, visit patterns shifted toward baseline levels, but ED visits by infants and toddlers remained depressed.

Key words: severe acute respiratory syndrome; SARS; visits, emergency department; respiratory illness

RÉSUMÉ

Objectifs : Examiner l'effet du syndrome respiratoire aigu sévère (SRAS) sur les visites au service des urgences d'un hôpital communautaire au cours de la phase initiale de la pandémie à Toronto en 2003 et pour la même période en 2004. L'accent a été mis sur les visites pour les maladies respiratoires (symptômes rappelant ceux du SRAS) dans différents groupes d'âges.

Méthodes : Il s'agit d'une étude rétrospective des diagnostics de congé du service des urgences obtenus à partir d'une banque de données informatisées, examinant une période de quatre semaines débutant le 28 mars pour les années 2001–2004. Le diagnostic de congé, l'âge et la date de la visite ont été obtenus pour chaque patient à l'urgence au cours des périodes pertinentes, puis ces données ont été comparées à celles des données de 2003 et 2004 avec une ligne de base

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dérivée du nombre moyen de visites au cours de 2001 et de 2002. Des regroupements ont été formés basés sur l'âge et les symptômes de maladie respiratoire.

Résultats : Au cours de la pandémie du SRAS en 2003, les visites à l'urgence ont décliné de 21 % (intervalle de confiance de 95 % [IC], 18 %–24 %) pour la période à l'étude de quatre semaines. La plus grande diminution était pour les visites combinées des bébés et des tout-petits (69 %; IC 95 %, 58 %–79 %); ces statistiques n'ont pas changé l'année suivante. Cependant, au cours de la pandémie du SRAS, il y a eu une forte augmentation du nombre de visites pour des maladies respiratoires chez les adultes (61 %; IC 95 %, 46 %–75 %) et chez les adolescents (132 %, IC 95 %, 82 %–182 %).

Conclusions : Au cours de la pandémie du SRAS, le nombre total de visites a chuté. La chute relative était particulièrement importante chez les bébés et les tout-petits. Par contre, il y a eu une augmentation des visites liées aux maladies respiratoires chez les adultes et les adolescents. En 2004, l'année suivant la pandémie du SRAS, le profil des visites s'est rapproché des niveaux de la ligne de base, mais le nombre de visites à l'urgence par les bébés et les tout-petits est demeuré faible.

Introduction

In March 2003, Toronto experienced an outbreak of SARS, a novel illness that originated in southern China and was transported to Toronto by one individual who had visited Hong Kong. Members of this person's family sought care in the emergency department (ED) of Scarborough Grace Hospital (the Grace), a community hospital in northeastern Toronto. The illness subsequently spread to hospital workers, other ED patients and eventually to other hospitals. To contain the spread of the virus, the Grace ED was closed on March 24, and full respiratory-illness precautions were instituted for all Toronto area hospitals on March 27.

Several reports have described the impact of previous infectious disease outbreaks on ED volumes. In May 1993, a Hantavirus outbreak in the southwestern United States led to a 2-fold increase in ED visits,¹ and a 1993 *Escherichia coli* 0157:H7 outbreak in Washington state increased ED visits by 17%.² More recent articles have documented how SARS outbreaks in Hong Kong,³ Taiwan,^{4,5} and Toronto⁶ reduced tertiary care ED visits.

Our objective was to examine the impact of the early stage of the SARS outbreak on ED visits at the Scarborough General Hospital, a community hospital situated 10 km from the Grace. We focused on the total number of ED visits and visits for respiratory-tract illness (SARS-like symptoms), stratified by age group. We also attempted to determine whether SARS-related volume changes persisted into the following year.

Methods

Design and setting

This was a retrospective observational study conducted at a single hospital, the Scarborough General Hospital (the

General), and was approved by the hospital's Research Ethics Board. The General, 1 of 3 community EDs in the Scarborough area of eastern Toronto, serves a multicultural community that is mostly working-class and new immigrant. The hospital has approximately 50 000 visits annually; half are female and 21% are under the age of 18. Visit acuity based on the *Canadian Emergency Department Triage and Acuity Scale* (CTAS)⁷ is: Level I, 0.8%; Level II, 16%; Level III, 50%; and Levels IV and V, 33%. Approximately 15% of patients are admitted from the ED.

To examine the impact of SARS on ED visits, we selected the 4-week time interval from Mar. 28 to Apr. 24, 2003 (immediately after the institution of strict infection control procedures in all Toronto area hospitals) as the "SARS period." After this time, it was likely that no one ED was perceived to be safer than another. The same 4-week periods during the years of 2001, 2002 and 2004 were examined for comparison purposes. We refer to the intervals in 2001 and 2002 as "pre-SARS," and to the 2004 interval as "post-SARS." Patients were included in the study if they visited the General ED during the 4-week study period within any of the 4 years.

Data collection

Prior to April 2002, patient diagnoses were extracted in *International Classification of Diseases*, 9th rev (ICD-9) format from the hospital's computerized database (Meditech; Medical Information Technologies Inc., Westwood, Mass.). After Apr. 1, hospital data submitted to the National Ambulatory Care Reporting System of the Canadian Institute for Health Information (CIHI) was obtained in ICD-10 format. ICD-9 data was converted to ICD-10, using a conversion table provided by CIHI. In addition, we rechecked all diagnostic codes obtained from the conversion table with the hospital data in order to confirm that

codes from the conversion table matched those that were used by the chart coders. The data included registration date, age and discharge diagnosis. Only one diagnosis was recorded per patient.

To identify patients with respiratory-related (or SARS-like) illnesses, we used the ICD-10 code for respiratory illness Jxx (i.e., codes beginning with "J") as well as the codes for fever, dyspnea, cough and viral illness. To examine the effect of age, 5 age groups were defined: infant/toddler (0–3 yr), child (4–12), teen (13–17), adult (18–64) and senior (≥ 65). A more general age categorization was also used: adult (≥ 18) and pediatric (0–17).

Data analysis

To compare the difference between the SARS and the pre-SARS periods, 2 approaches were considered for establishing the reference baseline: using only 1 preceding year, 2002 (following Del Beccaro and colleagues² and Man and coworkers³), or taking an average of the preceding years, 2001 and 2002 (following Boutis and associates⁶). Preliminary analysis showed that similar results would be obtained using either method. For the main outcomes, such as the number of total visits, observed values were compared with the reference baseline (similar to Johnston and colleagues⁸), and analyzed using a χ^2 test. The effects of categorical variables, such as age group and respiratory illness, were also examined using the χ^2 test. Confidence intervals and *p* values were derived based on a 5% significance level, and all tests were 2-sided.

A secondary analysis was based on mean daily visits, as proposed by Man and coworkers.³ Differences between periods were examined using the *t* test for normally distributed data or the Wilcoxon rank-sum test for non-parametric data. Again, a preliminary analysis suggested that findings would be similar using either of the 2 methods. Therefore, we report here the results with the reference baseline based on the average of pre-SARS intervals (2001 and 2002) and on the 4-week sums of visits.

Results

Figure 1 shows that during the SARS outbreak the total number of ED visits in the 4-week study period decreased by 21% relative to the previous 2 years (Table 1). Although there was marked variability in ED visit volume throughout the SARS period, there was a sharp decline after Mar. 26, 2003, when media reports about the outbreak intensified. The greatest decrease in visits during the SARS period was for infant/toddlers (69%), followed by children (42%) and teens (22%). Adult and senior visits declined by

13% and 16%, respectively. In the post-SARS study period, visits for all age groups, with the exception of infant/toddlers, recovered to $>90\%$ of the pre-SARS levels (Table 1); infant/toddler visits remained at 46% of the pre-SARS level.

Table 2 shows that there was a large increase in respiratory-related visits by adults (61%) and teenagers (132%); the combined respiratory-related visits of adults and teenagers, taken as a percentage of the total number of visits, rose from 4.2% pre-SARS to 9.0% over the SARS period. Visits by seniors declined slightly but not significantly, and visits by infants/toddlers and children decreased by 47% and 24%, respectively. Overall there was an 8% increase in respiratory-related visits that did not achieve statistical significance.

Discussion

Natural disasters, such as earthquakes, hurricanes and blizzards, tend to increase trauma-related ED visits.^{9–11} Infectious disease outbreaks differ in 2 important ways. During outbreaks, the ED may be perceived as both a place to seek medical care and a source of infection. Second, the public may not be directly aware of the outbreak except through media reports, and the tone of those news reports can influence the degree of perceived threat. By Mar, 2003, there was a steady stream of front-page stories in all Toronto daily newspapers focusing on the "mystery illness" and "killer pneumonia," the resultant deaths and the connection to the Grace ED,^{12–14} which coincided with a sharp decline in ED visits at the General (Fig. 1).

During the 4-week SARS study period, there was a 21% overall reduction in ED visits. Similar SARS-related declines were reported in Hong Kong, where ED visits fell 24% and 51% in the two 2-week study periods,³ and in Taiwan, where they fell by 33% at one hospital and 40% at another.^{4,5} In contrast, during the 1993 *E. coli* 0157:H7 outbreak in the Washington state area, ED visits increased by 17% at one pediatric hospital over a 4-month period, the majority of which were assessments for other gastroenteritis illnesses.² Similarly, visits initially doubled during the Hantavirus outbreak in 1993, although this may have been related to a media campaign urging people to seek medical attention if they had flu-like symptoms.¹ We believe that, during the initial stage of the SARS outbreak, fear of contracting the illness in the ED led to a reduction in visits, and that this trend was exacerbated after media coverage intensified. Media coverage of the Washington *E. coli* 0157:H7 outbreak did not have a negative effect on ED visits, possibly because spread requires direct contact, because it is a

well described illness, and because the outbreak was linked to having eaten at a specific restaurant chain.

In the early outbreak period, pediatric visits decreased by 47%, similar to the 45% decline seen at one hospital in Taiwan⁵ and the 48% reduction seen at a pediatric hospital in Toronto⁶ when both were affected by SARS. In 2004, 1 year after SARS, ED visits returned to >90% of the pre-SARS levels for all age groups except infant/toddlers, which remained at 46% of the pre-SARS level (Table 1). During an outbreak, parents would have to weigh their child's need for an immediate ED assessment against the potential risk of contracting the outbreak illness in an ED. The fact that infant/toddler visits remained depressed in 2004 suggests that there may have been lingering concern about the safety of the ED.

Table 2 shows that assessments for respiratory illness increased significantly for adults and teenagers; however, the overall increase in respiratory visits did not achieve significance because of the decline in infant/toddler and child

visits. Adults and teenagers are generally more likely to be exposed to the community at large, and therefore might perceive a greater risk of exposure than seniors and parents of small children. However, initial media reports associated the SARS outbreak with having visited the Grace,¹²⁻¹⁴ a factor that may have limited the number of respiratory illness-related visits.

Limitations

In order to compare visits from year to year, we assumed that the population base for the General did not change during the 4-year study period. However, with the temporary closure of the Grace ED, there would have been a redistribution of patients from the Grace catchment area to the surrounding hospitals, including the General, thereby increasing the number of ED visits during the outbreak.

The initial phase of the outbreak was defined as beginning the day following the implementation of strict infection-control procedures in all hospitals in the Toronto area, and as

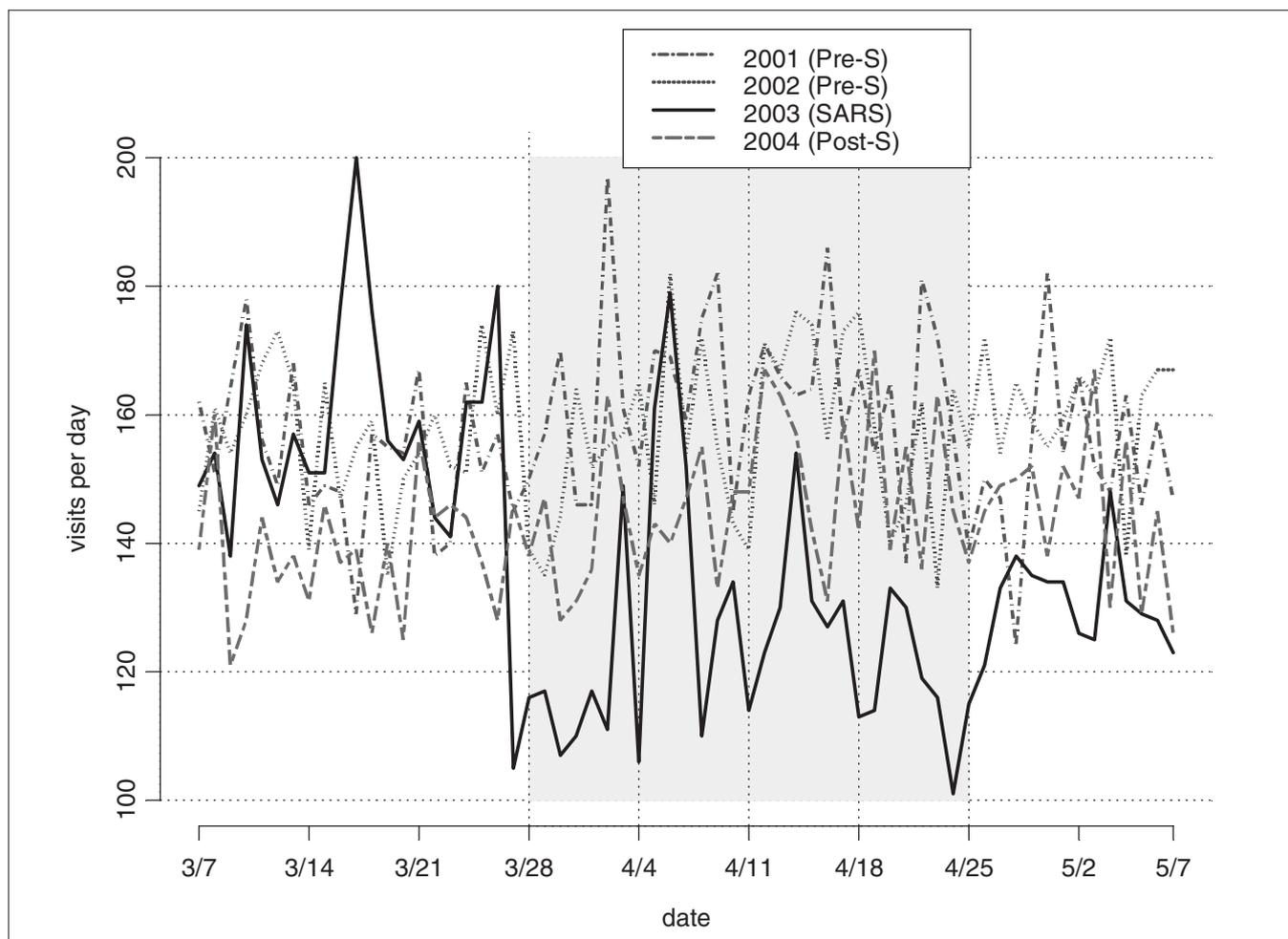


Fig. 1. Daily visits to the emergency department from March 7 to May 7 for the years 2001 to 2004. The 4-week SARS period of Mar. 28 to Apr. 24 is shaded. Pre-S = pre-SARS; Post-S = post-SARS

ending 4 weeks later. It would have been possible to select a longer period of data collection, up to week 8, when the second phase of the Toronto SARS outbreak had commenced. A period of less than 4 weeks would not have contained enough visits in certain categories to provide sufficient data for analysis. In addition, our baseline for comparing visits was constructed from 2 years of data, with significant variability between the 2 years for some age groups.

During the winter months, EDs experience a surge in visits for respiratory tract illness and gastroenteritis. This surge varies in timing and intensity from year to year, and may have had an impact on our results. Similarly, varia-

tion in weather conditions can affect ED visits. Furthermore, we do not know what percentage of patients seeking assessment for SARS used the ED versus other health care settings. SARS assessment clinics had been set up at other hospitals, and along with family doctors, these clinics would have seen patients seeking evaluation for SARS-like symptoms.

Finally, this study was carried out at 1 hospital, in close proximity to the epicentre of the outbreak. Whether the findings presented in this study are generalizable to other hospitals in similar outbreak scenarios has not been determined.

Table 1. No. of emergency department visits from March 28 to April 24 for the 4 study years (2001–2004)

Age group of patients, in years	Study year, no. (and %)* of visits				% of reference baseline (95% CI) based on average 2001–2002 volume	
	2001 (pre-SARS)	2002 (pre-SARS)	2003 (SARS)	2004 (post-SARS)	2003 (SARS)	2004 (post-SARS)
Infant/toddler (0–3)	456 (10)	227 (5)	107 (3)	156 (4)	31 (21–42)	46 (35–56)
Child (4–12)	374 (8)	459 (10)	243 (7)	379 (9)	58 (49–68)	91† (81–101)
Teenager (13–17)	201 (4)	250 (6)	175 (5)	234 (6)	78 (65–91)	104† (91–117)
Adult (18–64)	2457 (54)	2490 (57)	2140 (60)	2312 (56)	87 (83–90)	93 (90–97)
Senior (≥65)	1094 (24)	972 (22)	868 (25)	1027 (25)	84 (78–90)	99† (93–106)
<18	1031 (23)	936 (21)	525 (15)	769 (19)	53 (47–60)	78 (72–84)
≥18	551 (78)	3462 (79)	3008 (85)	3339 (81)	86 (82–89)	95 (92–99)
Total no. of visits	4582	4398	3533	4108	79 (76–82)	91 (89–94)

CI = confidence interval

*All percentages have been rounded.

†Not significant at 5% significance level.

Note: The percentage changes for the SARS and post-SARS periods are calculated relative to the pre-SARS reference baseline based on the average of the years 2001 and 2002.

Table 2. Emergency department visits for respiratory illness* from March 28 to April 24 for the 4 study years (2001–2004)

Age group of patients, in years	Study year, no. (and %)† of visits				% of reference baseline (95% CI) based on average of 2001–2002	
	2001 (pre-SARS)	2002 (pre-SARS)	2003 (SARS)	2004 (post-SARS)	2003 (SARS)	2004 (post-SARS)
Infant/toddler (0–3)	118 (23)	60 (12)	47 (9)	46 (10)	53 (32–74)	52 (31–72)
Child (4–12)	81 (16)	126 (25)	79 (14)	92 (20)	76 (57–96)	89‡ (70–108)
Teenager (13–17)	9 (2)	22 (4)	36 (7)	31 (7)	232 (182–282)	200 (150–250)
Adult (18–64)	157 (31)	193 (38)	281 (51)	175 (37)	161 (146–175)	100‡ (85–115)
Senior (≥65)	141 (28)	103 (21)	102 (19)	124 (26)	84‡ (66–101)	102‡ (84–119)
<18	208 (41)	208 (41)	164 (30)	169 (36)	78 (64–91)	81 (68–95)
≥18	298 (59)	296 (59)	383 (70)	99 (64)	129 (118–140)	101‡ (89–112)
Total no. of visits	506	504	545	468	108‡ (99–117)	93‡ (84–101)

CI = confidence interval

*Respiratory illness includes ICD-10 Jxx (i.e., codes beginning with "J"), as well as fever, viral illness, cough and dyspnea.

†All percentages have been rounded.

‡Not significant at 5% significance level.

Note: The SARS and post-SARS periods are compared to the pre-SARS reference baseline based on the average of the years 2001 and 2002.

Conclusions

During the SARS outbreak, there was a decrease in total visits. The relative decline was most notable for infants and toddlers. By contrast, there was an increase in respiratory illness-related visits for adults and teenagers. In the year following the SARS outbreak, visit patterns shifted toward baseline levels, but ED visits by infants and toddlers remained depressed. Understanding how ED volumes changed in response to SARS will help to anticipate ED utilization in the event of future outbreaks and in the post-outbreak period.

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Competing interests: None declared.

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