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A comparison of infection control program resources, activities, and antibiotic resistant organism rates in Canadian acute care hospitals in 1999 and 2005: Pre- and post-severe acute respiratory syndrome

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Background: The Resources for Infection Control in Hospitals (RICH) project assessed infection control programs and rates of antibiotic-resistant organisms (AROs) in Canadian acute care hospitals in 1999. In the meantime, the severe acute respiratory syndrome (SARS) outbreak and the concern over pandemic influenza have stimulated considerable government and health care institutional efforts to improve infection control systems in Canada.

Methods: In 2006, a version of the RICH survey similar to the original RICH instrument was mailed to infection control programs in all Canadian acute care hospitals with 80 or more beds. We used χ^2, analysis of variance, and analysis of covariance analyses to test for differences between the 1999 and 2005 samples for infection control program components and ARO rates.

Results: 72.3% of Canadian acute care hospitals completed the RICH survey for 1999 and 60.1% for 2005. Hospital size was controlled for in analyses involving AROs and surveillance and control intensity levels. Methicillin-resistant *Staphylococcus aureus* (MRSA) rates increased from 1999 to 2005 ($F = 9.4$, $P = .003$). In 2005, the mean MRSA rate was 5.2 (standard deviation [SD], 6.1) per 1000 admissions, and, in 1999, it was 2.0 (SD, 2.9). *Clostridium difficile*-associated diarrhea rates trended up from 1999 to 2005 ($F = 2.9$, $P = .09$). In 2005, the mean *Clostridium difficile*-associated diarrhea rate was 4.7 (SD, 4.3), and, in 1999, it was 3.8 (SD, 4.3). The proportion of hospitals that reported having new nosocomial vancomycin-resistant *Enterococcus* (VRE) cases was greater in 2005 than in 1999 ($\chi^2 = 10.5$, $P = .001$). In 1999, 34.5% (40/116) of hospitals reported having new nosocomial VRE cases, and, in 2005, 61.0% (64/105) reported new cases. Surveillance intensity index scores increased from a mean of 61.7 (SD, 18.5) in 1999 to 68.1 (SD, 15.4) in 2005 ($F = 4.1$, $P = .04$). Control intensity index scores trended upward slightly from a mean of 60.8 (SD, 14.6) in 1999 to 64.1 (SD, 12.2) in 2005 ($F = 3.2$, $P = .07$). Infection control professionals (ICP) full-time equivalents (FTEs) per 100 beds increased from a mean of 0.5 (SD, 0.2) in 1999 to 0.8 (SD, 0.3) in 2005 ($F = 90.8$, $P < .0001$). However, the proportion of ICPs in hospitals certified by the Certification Board of Infection Control decreased from 53% (SD, 46) in 1999 to 38% (SD, 36) in 2005 ($F = 8.7$, $P = .004$).

Conclusion: Canadian infection control programs in 2005 continued to fall short of expert recommendations for human resources and surveillance and control activities. Meanwhile, nosocomial MRSA rates more than doubled between 1999 and 2005, and hospitals reporting new nosocomial VRE cases increased 77% over the same period. Although investments have been made toward infection control programs in Canadian acute care hospitals, the rapid rise in ICP positions has not yet translated into marked improvements in surveillance and control activities. In the face of substantial increases in ARO rates in Canada, continued efforts to train ICPs and support hospital infection control programs are necessary. (Am J Infect Control 2008;36:711-7.)

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The Resources for Infection Control in Hospitals (RICH) project surveyed the state of infection control programs in Canadian acute care hospitals in 1999.[1,2] This Canada-wide survey identified widespread deficits in infection control program resources, surveillance, and control activities[1] and provided national rates of methicillin-resistant *Staphylococcus aureus* (MRSA), *Clostridium difficile*-associated diarrhea (CDAD), and vancomycin-resistant *Enterococcus* (VRE).[2] Since 1999, the outbreak of severe acute respiratory syndrome (SARS), the worldwide increasing rates of antibiotic-resistant organisms (AROs), and the specter of pandemic influenza continue to underscore the critical

need for effective infection control programs.[3-5] We examined the extent to which infection control program resources and activities improved from 1999 to 2005 in Canadian acute care hospitals and whether ARO rates have changed during the same time frame.

METHODS

Survey

In March of 2006, all acute care hospitals in Canada with 80 or more beds were mailed a bilingual cover letter and the 2005 version of the RICH survey regarding the state of infection control in their facility. A list of 233 eligible hospitals was compiled from the 2005 Canadian Health Facilities Directory. The staff member most responsible for the infection control program was asked to complete the survey. If an infection control program was responsible for multiple hospitals within a larger health organization, aggregated data were accepted if data for individual hospitals were not available. Advertisements in the *Canadian Journal of Infection Control* and on the Community and Hospital Infection Control Association (CHICA)-Canada Web site (www.chica.org) and memos to CHICA-Canada chapter presidents were used to optimize response, and nonresponders were sent a second survey.

The 2005 version of the RICH survey incorporated the original RICH instrument,[1] allowing for the calculation of surveillance and control index scores and the assessment of infection control program resources (Table 1). The survey items that assessed program resources and composed the surveillance and control indices were identical in the 1999 and 2005 versions of the survey. The 23 items in the surveillance index assessed the collection and dissemination of infection data, and the 44 items in the control index measured the activities and policies directed toward the reduction of infections in hospitals. Scores of 100 on the surveillance and control indices indicated that all effective activities were being conducted. Respondents were asked to provide the number of any and all (colonized and infected) new nosocomial cases of MRSA, VRE, and CDAD for 2005 in their hospital. The identical method was used to assess MRSA, VRE, and CDAD rates in Canadian acute care hospitals in 1999.[2]

Statistical analysis

Data were analyzed with use of StatView version 5.0 (SAS Institute, Cary, NC). Analysis of variance (ANOVA) analysis was used to test for differences between the 1999 and 2005 samples for hospital size, and χ^2 analysis was used to test for differences between the 1999 and 2005 samples for hospital teaching status and regional representation. If differences in composition between the 1999 and 2005 samples were found for hospital size, hospital teaching status, or regional representation, regression analyses were used to test their association with dependent variables.

ANOVA or analysis of covariance (ANCOVA), depending on the regression analysis, were used to test for differences between the 1999 and 2005 samples for MRSA and CDAD rates, surveillance and control index scores, physician and doctoral level professionals and secretarial service hours, infection control professional (ICP) hours, ICP experience in infection control, and ICP infection control certification levels. Multiple *t* tests with the Bonferroni correction were used to examine for regional differences between 1999 and 2005 for MRSA and CDAD rates, surveillance and control index scores, and ICP staffing levels.[6] The conservative Bonferroni correction decreases the incidence of false-positive results when conducting multiple comparisons by decreasing α levels as the number of comparisons rises.

The VRE dependent variable was dichotomized as hospitals with and without new nosocomial VRE cases because, in 1999, two thirds of hospitals in the RICH sample did not have any new nosocomial VRE cases. Logistic regression analysis was used to test for differences between the 1999 and 2005 samples for the presence of VRE, hospitals with secretarial support, hospitals with physician and doctoral level professionals providing service, hospitals with physician and doctoral professionals with formal infection control training, and computer resources. The χ^2 test analysis with Bonferroni correction was used to test for regional differences between 1999 and 2005 for the presence of new nosocomial VRE cases.

RESULTS

The response rate for the 2005 survey was 60.1%; 113 surveys were received, representing 140 of 233 eligible facilities. Eighteen surveys were received from larger organizations that represented up to 4 eligible hospitals. One survey was returned without identifying the respondent or the hospital, and 2 were not included because of incomplete information. The response rate for the 1999 survey was 72.3%.[1]

Sample characteristics

The size of the respondent hospitals increased in the 6 years between surveys ($F = 4.5$, $P = .03$). Mean hospital size in 1999 was 292.4 (standard deviation [SD], 237.6) beds with a median of 230.0. Mean hospital size in 2005 was 363.1 (SD, 292.9) beds with a median of 289.0. An examination of the proportion of hospitals in the 1999 and 2005 samples for 3 size

Table 1. Items included in the Resources for Infection Control in Hospitals survey questionnaire

- Hospital characteristics
  - Bed numbers
  - Admissions
- New nosocomial cases of antibiotic-resistant organisms
  - MRSA
  - VRE
  - CDAD
- Infection control program resources
  - ICPs
    - Time devoted to infection control and specific activities
    - Professional category
    - Certified by Certification Board of Infection Control
  - Physicians/doctoral professionals
    - Time devoted to infection control and specific activities
    - Infection control training
    - Secretarial support provided to infection control program
  - Laboratory
    - Access to daily reports on cultures
    - Surveillance cultures for evaluating possible outbreaks
  - Computers
    - Computers used for tabulation of infection data and infection reports
    - Use of statistical software to analyze data collected
  - References
    - Infection control journals and texts
    - Internet access
    - Current Health Canada guidelines on preventing nosocomial infections
- Surveillance/case finding of infections
  - Denominator data collected
  - Specific statistics collected for infections on wards, units, or service
  - Infections involving particular anatomic sites or medical devices
  - Specific statistics collected for MRSA, VRE, CDAD
  - Surgical site infections calculated and reported to surgeons
  - Case-finding methods used to detect new cases of nosocomial infections
- Infection control activities
  - Infection control teaching activities
  - Communicated hospital's infection data to patient care staff
  - Circulated scientific information on infection control to patient care staff
  - Infection control authority
    - Direct authority to close wards or units to further admissions
    - Direct authority to have patients placed in isolation
  - Infection control policies
    - Isolation precautions for patients with VRE
    - Isolation precautions for patients with MRSA
    - Insertion, maintenance, and changing of IVs, tubing, and solutions
    - Respiratory precautions for tuberculosis and other airborne infections
    - Aseptic insertion and maintenance of closed drainage of Foley catheters
    - Routine system for changing breathing circuits on patients undergoing ventilation
    - Isolation precautions for patients with diarrhea associated with *Clostridium difficile*
    - The indications, drug choices, timing, and duration of perioperative antibiotics

MRSA, methicillin-resistant *Staphylococcus aureus*; *VRE*, vancomycin-resistant *Enterococci*; *CDAD*, *Clostridium difficile*-associated diarrhea.

categories—hospitals with less than 200 beds, hospitals with 200 to 399 beds, and hospitals with 400 plus beds—indicated a trend for hospital size category differences between the samples ($\chi^2 = 5.7$, $P = .06$). The post hoc cell contributions showed that hospitals with less than 200 beds comprised a greater proportion of the 1999 sample than the 2005 sample ($Z = 2.3$, $P = .01$).

The proportion of teaching hospitals participating in the survey did not differ between 1999 and 2005 ($\chi^2 = 0.5$, $P = .5$). In 1999, 23.4% (34/145) of the sample was composed of teaching hospitals, and, in 2005, 27.3% (30/110) of the sample was teaching hospitals.

Hospitals were grouped into 4 geographic regions: the West region consisted of hospitals in British Columbia, Alberta, Saskatchewan, and Manitoba; the provinces of Ontario and Quebec were each separate regions; and the Atlantic region consisted of New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland, and Labrador. Regional representation did not differ between the 1999 and 2005 samples ($\chi^2 = 2.6$, $P = .5$).

Association of hospital size with dependent variables

Larger hospitals were associated with higher MRSA rates ($r = 0.19$, $P = .005$), with higher CDAD rates ($r = 0.22$, $P = .003$), and with more new nosocomial VRE cases ($\chi^2 = 31.5$, $P < .0001$). Higher surveillance index scores ($r = 0.23$, $P = .0002$) and higher control index scores ($r = 0.34$, $P < .0001$) were associated with the number of hospital beds. Hospital size was not associated with ICP full-time equivalents (FTEs) per 100 beds ($r = -0.01$, $P = .9$) nor with the proportion of ICPs Certification Board of Infection Control (CBIC) certified ($r = 0.04$, $P = .5$) nor with years of infection control experience of ICPs ($r = 0.08$, $P = .2$). The percentage of infection control programs with physician and or doctoral level professionals providing service was positively associated with hospital size ($\chi^2 = 18.6$, $P < .0001$) as was whether physician and or doctoral level professionals had infection control training or expertise ($\chi^2 = 3.7$, $P = .05$). Physician and doctoral level professionals hours per 250 beds were not associated with hospital size ($r = -0.11$, $P = 0.2$). Hospital size was associated with having secretarial support ($\chi^2 = 20.6$, $P < .0001$); however, not with the number of secretarial hours ($r = -0.03$, $P = .7$). Whether infection control programs used computers to generate infection reports was correlated with hospital size ($\chi^2 = 16.2$, $P < .0001$), and hospital size was not associated with whether statistical or specialized infection control software was used ($\chi^2 = 2.1$, $P = .1$).

Table 2. Unpaired means comparisons for MRSA and CDAD rates in 1999 and 2005 by Canadian region

	Mean MRSA rate/1000 admissions (SD)				Mean CDAD rate/1000 admissions (SD)		
Region	**1999**	**2005**	***P* value***	**Region**	**1999**	**2005**	***P* value**
West (n = 59)	1.6 (2.9)	3.6 (3.5)	.02	West (n = 49)	3.3 (3.3)	4.5 (4.7)	.3
Ontario (n = 85)	2.8 (2.9)	3.8 (3.4)	.1	Ontario (n = 71)	4.2 (4.0)	3.6 (2.1)	.4
Quebec (n = 37)	2.8 (3.8)	11.2 (9.6)	.0009	Quebec (n = 27)	7.9 (7.5)	8.6 (6.2)	.8
Atlantic (n = 37)	0.2 (0.3)	5.1 (6.6)	.002	Atlantic (n = 31)	1.7 (1.2)	3.3 (3.4)	.08
Overall (n = 222)	2.0 (2.9)	5.2 (6.1)	.003	Overall (n = 182)	3.8 (4.3)	4.7 (4.3)	.09

MRSA, methicillin-resistant *Staphylococcus aureus*; *CDAD*, *Clostridium difficile*-associated diarrhea.
*Because of the Bonferroni correction, regional comparisons in this Table are not significant unless the corresponding *P* value is less than .0125.

AROs

MRSA rates, controlling for the number of hospital beds, increased from 1999 to 2005 (F = 9.4, P = .003). In 2005, the mean MRSA rate for all responding hospitals across Canada was 5.2 (SD, 6.1) per 1000 admissions, whereas the MRSA rate in 1999 was 2.0 (SD, 2.9). MRSA rates increased in Quebec (t = 3.6, P = .0009) and the Atlantic region (t = 3.4, P = .002) from 1999 to 2005 (Table 2).

Mean CDAD rates, controlling for the number of hospital beds, trended up from 1999 to 2005 (F = 2.9, P = .09). In 2005, the mean CDAD rate was 4.7 (SD, 4.3) per 1000 admissions, and, in 1999, it was 3.8 (SD, 4.3). Regional CDAD rates did not differ from 1999 to 2005 (Table 2).

The proportion of hospitals that reported having new nosocomial VRE cases, controlling for the number of hospital beds, was greater in 2005 than in 1999 (χ^2 = 10.5, P = .001). In 1999, 34.5% (40/116) of hospitals reported having new nosocomial VRE cases, and, in 2005, 61.0% (64/105) of hospitals reported having new nosocomial VRE cases. The proportion of hospitals in Quebec with new nosocomial VRE cases increased from 1999 to 2005 from 21.1% (4/19) hospitals to 72.2% (13/18) (χ^2 = 9.7, P = .002) (Table 3). In 2005, the mean VRE rate across Canada was 1.0 (SD, 1.8) per 1000 admissions, and, in 1999, the overall rate was 0.4 (SD, 1.5).

Surveillance and control indices

Overall, surveillance index scores, controlling for the number of hospital beds, increased only slightly from a mean of 61.7 (SD, 18.5) in 1999 out of a maximum of 100 to 68.1 (SD, 15.4) in 2005 (F = 4.1, P = .04). In Ontario, however, surveillance index scores increased in a significant fashion from 63.5 (SD, 15.9) in 1999 to 72.4 (SD, 12.7) in 2005 (t = 2.9, P = .004) (Table 4).

Control index scores, controlling for the number of hospital beds, trended upwards slightly from a mean of 60.8 (SD, 14.6) out of a maximum of 100 in 1999 to 64.1 (SD, 12.2) in 2005 (F = 3.2, P = 0.07). In Quebec, control index scores increased significantly from 53.3 (SD, 15.7) in 1999 to 64.5 (SD, 10.0) in 2005 (t = 2.7, P = .01) (Table 4).

Table 3. Comparisons of new nosocomial cases of VRE in 1999 and 2005 by Canadian region

	Proportion of hospitals with new nosocomial VRE cases		
Region	**1999**	**2005**	***P* value***
West	13/34 (0.38)	12/25 (0.48)	.5
Ontario	19/41 (0.46)	31/45 (0.69)	.03
Quebec	4/19 (0.21)	13/18 (0.72)	.002
Atlantic	4/22 (0.18)	8/17 (0.47)	.05
Overall	40/116 (0.35)	64/105 (0.61)	.001

VRE, vancomycin-resistant *Enterococci*.
*Because of the Bonferroni correction, regional comparisons in this Table are not significant unless the corresponding *P* value is less than .0125.

Human resources

ICP FTEs per 100 beds increased from a mean of 0.5 (SD, 0.2) in 1999 to 0.8 (SD, 0.3) in 2005 (F = 90.8, $P <$ .0001). ICP FTEs per 100 beds increased in Ontario (t = 6.9, $P <$ .0001), Quebec (t = 7.8, $P <$ .0001), and the Atlantic region (t = 3.1, P = .004) from 1999 to 2005 (Table 5). The proportion of ICPs in hospitals certified by the CBIC decreased from 53% (SD, 46) in 1999 to 38% (SD, 36) in 2005 (F = 8.7, P = .004). The mean years of infection control experience of ICPs decreased from 9.0 (SD, 5.8) in 1999 to 7.2 (SD, 5.2) in 2005 (F = 6.2, P = .01).

The percentage of infection control programs with physician and or doctoral level professionals providing service, controlling for hospital size, was similar in 1999 (71.7%) and 2005 (70.9%) (χ^2 = 1.0, P = .3). In hospitals with physician and doctoral level professionals providing service to infection control programs, physician and doctoral level professionals mean hours of service per week per 250 beds in 1999 was 6.8 (SD, 8.0), similar to the 8.5 hours of service provided in 2005 (SD, 11.2) (F = 1.4, P = .2). The percentage of infection control programs with physician and or

Table 4. Unpaired means comparisons for surveillance and control index scores in 1999 and 2005 by Canadian region

Region	Mean surveillance scores (SD)			Mean control scores (SD)		
	1999	2005	*P* value*	1999	2005	*P* value
West (n = 69)	64.2 (18.1)	64.4 (16.6)	.96	63.0 (16.9)	60.3 (11.7)	.5
Ontario (n = 91)	63.5 (15.9)	72.4 (12.7)	.004	61.8 (12.6)	67.5 (13.3)	.04
Quebec (n = 42)	46.3 (22.5)	61.0 (17.9)	.03	53.3 (15.7)	64.5 (10.0)	.010
Atlantic (n = 37)	70.2 (9.7)	70.2 (14.4)	.98	62.7 (9.9)	60.0 (10.1)	.4
Overall (n = 244)	61.7 (18.5)	68.1 (15.4)	.04	60.8 (14.6)	64.1 (12.2)	.07

*Because of the Bonferroni correction, regional comparisons in this Table are not significant unless the corresponding *P* value is less than .0125.

Table 5. Unpaired means comparisons for ICP staffing levels in 1999 and 2005 by Canadian region

Region	Mean ICP FTEs per 100 beds (SD)		
	1999	2005	*P* value*
West (n = 70)	0.43 (0.17)	0.55 (0.24)	.02
Ontario (n = 95)	0.49 (0.21)	0.87 (0.33)	<.0001
Quebec (n = 42)	0.33 (0.12)	0.73 (0.21)	<.0001
Atlantic (n = 39)	0.54 (0.27)	0.84 (0.35)	.004
Overall (n = 251)	0.45 (0.21)	0.77 (0.32)	<.0001

ICP, infection control professionals; *FTEs*, full-time equivalents.
*Because of the Bonferroni correction, regional comparisons in this Table are not significant unless the corresponding P value is less than .0125.

doctoral level professionals who had infection control training, controlling for hospital size, was similar in 1999 (81.7%) and 2005 (88.5%) ($\chi^2 = 0.7$, $P = .4$).

The percentage of infection control programs with secretarial support, controlling for hospital size, was similar in 1999 (69.0%) and 2005 (67.3%) ($\chi^2 = 1.4$, $P = .2$). Among those hospital infection control programs with secretarial support, secretarial hours per 250 beds was greater in 2005 than in 1999 ($F = 4.6$, $P = .03$) with a mean of 12.5 (SD, 9.2) hours per 250 beds and 9.1 (SD, 10.7) for 2005 and 1999, respectively.

Computer resources

A significantly greater percentage of infection control programs in 2005 used computers for the purposes of tabulating infection data and preparing reports of infections, controlling for hospital size, than in 1999 ($\chi^2 = 17.3$, $P < .0001$). In 1999, 67% (97/145) of infection control programs used computers for tabulating and reporting infection data, and, by 2005, 93% (102/110) used computers. Among those infection control programs that used computers for the purposes of tabulating infection data and preparing reports of infections, the use of statistical or specialized infection control software decreased from 1999 to 2005 ($\chi^2 = 8.2$, $P = .004$). In 1999, 56% (54/97) of infection control programs used statistical or specialized infection control software, and, in 2005, 35% (36/102) used statistical or specialized infection control software.

DISCUSSION

There have been 2 major events in Canada since 1999 that put hospital infection prevention and control under the spotlight in a very public way: The SARS outbreak in 2003 in Toronto, Ontario, and the CDAD outbreak in several cities in Quebec between 2002 and 2004. Both of these outbreaks that affected Canadian hospitals have been the subject of public commissions or inquiries as well as intense media scrutiny.[7-12] The SARS Commission in Ontario and the National Advisory Committee on SARS and Public Health among others placed high emphasis on resources being placed into infection prevention and control programs in Canadian hospitals. It was against this backdrop that we conducted the present study to evaluate the state of infection control programs and ARO rates in Canadian acute care hospitals and compare them with those of our previous study of 1999.[1,2] The similar methodology used in both studies allowed for direct comparisons between infection control programs and ARO rates in 1999 and 2005. Furthermore, the response rates of the 1999 and 2005 surveys indicated that both samples were representative of Canadian acute care hospitals with 80 or more acute care beds.

ARO rates are increasing in Canada and many jurisdictions around the world.[13-17] The overall nosocomial MRSA rates for Canadian acute care hospitals participating in our survey more than doubled between 1999 and 2005, and the number of hospitals reporting new nosocomial VRE cases in Canada increased 77% over the same period. The MRSA and VRE rates of the present study are in line with the nosocomial MRSA and VRE rates reported for large Canadian teaching hospitals.[16,17] We did not find national or regional increases in nosocomial CDAD between 1999 and 2005. This may have been due to infection control efforts directed toward CDAD that resulted from the numerous deaths associated with outbreaks of the hypervirulent NAP1 strain in Quebec between 2002 and 2004.[10]

Nevertheless, CDAD rates were higher in Quebec than the rest of Canada in 1999 ($t = 3.4$, $P = .001$) and 2005 ($t = 4.7$, $P < .0001$).

Surveillance scores increased roughly 6%, and control scores trended up from 1999 to 2005. Despite the minor increases in surveillance and control intensity, 15% of hospitals in our 2005 sample scored less than 50 on the surveillance index, indicating that they conducted less than half of the recommended surveillance activities. Only 27% of infection control programs conducted greater than 80% of recommended surveillance activities. The findings are similar for control activities; 10% of infection control programs scored less than 50 on the control index, and only 11% scored greater than 80%.

The situation is mixed as to whether human resources available to infection control programs improved from 1999 to 2005. Physician, doctoral professionals, and secretarial support to infection control programs changed little from 1999 to 2005, whereas ICP FTEs per 100 beds increased 60% overall. However, even with increased ICP staffing, less than one quarter (22.6%) of hospitals had the recommended 1 FTE ICP per 100 beds in 2005.[18] The proportion of ICPs with CBIC certification actually decreased from 1999 to 2005. This decrease in certification levels may be due to the requirement for recently hired ICPs to practice in infection control for 2 years with a minimum of 800 hours experience before being eligible to write the CBIC certification examination (www.cbic.org). On average, ICPs had almost 2 years less experience in infection control in 2005 when compared with ICPs in 1999, reflecting recent entrants into the field.

A greater percentage of ICPs used computers for tabulating infection data and preparing reports of infections in 2005 than in 1999; however, the overall use of statistical or specialized infection control software decreased from 1999 to 2005. The decrease in the use of statistical or specialized infection control software might be because fewer of the recently hired ICPs have received training to use these programs and/or there is a lack of resources for the software and more use of spreadsheet and database programs that are available on many hospital computer systems.

Crises appear to drive increases in infection surveillance and control resources and activities. Increases in ICP staffing and the intensity of control activities in Quebec coincided with the CDAD outbreak in Quebec. Similarly, increases in ICP staffing and the intensity of surveillance activities in Ontario coincided with the SARS outbreak of 2003. Despite these crises-motivated influxes of resources, Canadian infection control programs in 2005 continue to fall short of expert recommendations with respect to the intensity of surveillance and control activities and infection control program human resources.[18-20] Taking into account hypervirulent *C difficile* strains, the predicted influenza pandemic, and increasing rates of MRSA and VRE, there continues to be great need for ongoing investment in infection control programs.[3-5,21] If Canada is to achieve widespread control of infections in acute care hospitals, increased investments in infection control human resources are required in the form of more infection control professionals, their training, and certification with CBIC. Infection control programs also require physicians trained in infection control, surveillance tools, and support staff to mount effective control programs and to report on nosocomial infection rates. The size and scope of the ARO problem is increasing, yet there is accumulating evidence that properly designed and executed infection control programs are highly effective and cost beneficial.[21] To not continue to make these investments now is very shortsighted and suggests that we may have already forgotten the lessons we were to have learned from the outbreaks of SARS and hypervirulent *C difficile*.

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