

# Infection control practices related to *Clostridium difficile* infection in acute care hospitals in Canada

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**Background:** We carried out a survey to identify the infection prevention and control practices in place in Canadian hospitals participating in the Canadian Nosocomial Infection Surveillance Program (CNISP).

**Methods:** An infection prevention and control practices survey was sent to CNISP hospitals at the beginning of November 2004, the same time that CNISP started a 6-month prospective surveillance for *Clostridium difficile* infection (CDI) to evaluate their infection prevention and control measures and laboratory methods for *C difficile*.

**Results:** A total of 33 hospitals completed and returned the survey. Infection control precautions were initiated in 18 hospitals (55%) due to the presence of a symptomatic patient before the *C difficile* laboratory tests were available. All of the hospitals used gloves and gowns as additional precautions. Twenty-three hospitals (70%) tested liquid stools based on a clinician's order, and 8 (24%) tested all liquid stools submitted whether or not *C difficile* testing was requested. The hospitals used 1 of 3 different products as a standard hospital-wide disinfectant; 24 (73%) used a quaternary ammonium compound, 8 (24%) used accelerated hydrogen peroxide, and 1 (3%) used a hypochlorite solution (1:10 bleach solution).

**Conclusion:** Although the hospitals used contact precautions quite uniformly, considerable variation was seen among hospitals in terms of testing strategies, cleaning and disinfection protocols and products, and isolation practices. The timing for the initiation of infection control precautions is important to prevent secondary transmission of CDI. Most of the hospitals implemented precautions while waiting for the toxin assay results. (Am J Infect Control 2009;37:9-14.)

*Clostridium difficile* is the most important and common cause of health care-associated diarrhea in adults in the developed world.<sup>1,2</sup> Relapses of *C difficile* infection (CDI) are common, adding to the prevalence.<sup>3</sup> Recently, CDI rates have increased in North America and Western Europe,<sup>3-6</sup> associated with the spread of a hypervirulent clone. Not only are the rates increasing, but the clinical picture of CDI is becoming more

severe,<sup>7,8</sup> resulting in worse clinical outcomes and increased numbers of admissions to intensive care units.<sup>9</sup>

Hospitals are important reservoirs for *C difficile*,<sup>1,10,11</sup> and studies have shown that the single most successful strategy in preventing the development of CDI may be antimicrobial stewardship.<sup>1,2,11-14</sup> Compared with the evidence supporting the effectiveness of antimicrobial stewardship, there are less convincing data to accurately quantify the efficacy of most infection control measures aimed at reducing *C difficile* transmission.<sup>11,12</sup> Nevertheless, strict application of infection control measures has proven effective in reducing the incidence of CDI in hospitalized adults,<sup>15-17</sup> and lapses in infection control measures have been associated with health care-acquired outbreaks of CDI.<sup>18</sup> In the present study, we performed a cross-sectional survey aimed at identifying the infection prevention and control practices in place in Canadian hospitals participating in the Canadian Nosocomial Infection Surveillance Program (CNISP).

## METHODS

CNISP is a collaborative effort of the Canadian Hospital Epidemiology Committee, a subcommittee of the Association of Medical Microbiology and Infectious Disease Canada and the Centre for Communicable Diseases and Infection Control of the Public Health

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Agency of Canada (PHAC). At the time of this survey, 41 sentinel hospitals from 9 provinces were participating in CNISP. All CNISP hospitals have a university affiliation and provide primary, secondary, and tertiary care to adult and/or pediatric patients. The infection prevention and control practices survey was sent to CNISP hospitals at the beginning of November 2004. Demographic data, including numbers of beds and programs provided, were collected on all facilities. Information about CDI included method of testing for CDI, number of tests for CDI per year, and number of CDI outbreaks in the previous year. An outbreak was defined as any nosocomial transmission of CDI within the facility thought to be epidemiologically linked to another person with CDI by common exposures, shared rooms, and contact with an implicated health care worker or another patient with CDI. Outbreaks were identified using the best judgment of the infection control professional completing the survey forms. Information about infection control practices included additional precautions for patients testing positive for CDI, use of infection control practices by visitors to CDI-positive patients, and housekeeping (ie, cleaning and disinfection of rooms housing CDI-positive patients). Information also was gathered on hospital testing of liquid stools, including testing methods.

Data were collected on manually completed data extraction forms and forwarded to the PHAC for data entry and analysis. The data were entered into a customized database mirroring the data extraction form (MS Access version 2002) and analyzed using Microsoft Office Excel. A unique identifier was assigned to each participating hospital, and the data were kept strictly confidential. Thus, only cumulative descriptive data could be reported, because individual facilities were not identified. Although this study was observational and did not involve any alteration in patient care, ethics approval was sought at those hospitals for which it was required.

## RESULTS

A total of 34 acute care hospitals participated in the 6-month prospective surveillance for CDI. Of these, 33 completed the infection prevention and control practices survey. Of these hospitals, 19 (58%) were combined adult/pediatric hospitals, 10 (30%) were adult-only hospitals, and 4 (12%) were pediatric hospitals. The average size of the participating hospitals was  $426 \pm 267$  beds (range, 76 to 1169 beds). Twenty-six hospitals (79%) had an infection control program in place with at least 1 hospital epidemiologist and an average of 1 infection control professional per 150 beds or less, whereas the remaining 7 (21%) hospitals had 1 infection control professional per 150 to 250 beds.

**Table 1.** Frequency of adherence to infection control guidelines for CDI by participating hospitals (n = 33)\*

| Recommended infection control practice     | Number of hospitals adhering to the practice (%) |
|--|--|
| Precautions initiated at onset of symptoms | 18 (55)  |
| Single room or cohorting                   | 29 (88)  |
| Gloves                                     | 33 (100)   |
| Gowns                                      | 33 (100)   |
| Dedicated equipment                        | 27 (82)  |
| Barriers used by visitors                  | 23 (70)  |

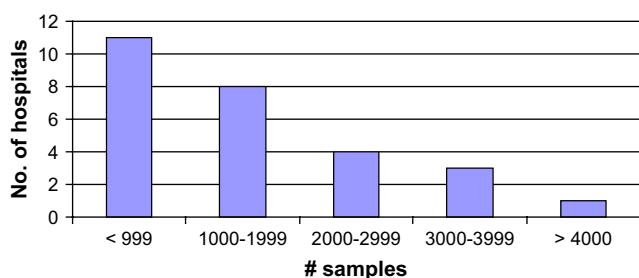
\*PHAC infection control guideline series, Routine Practices and Additional Precautions for Preventing the Transmission of Infection in Health Care.

Infection control precautions had been initiated in 18 hospitals (55%) due to the presence of a symptomatic patient before laboratory tests for *C difficile* were available. The remaining hospitals initiated precautions once *C difficile* was confirmed. All hospitals used gloves and gowns as additional precautions (Table 1). One hospital used masks. There was no difference in the treatment of intensive care unit (ICU) and non-ICU patients in any of the hospitals (Table 2). Two different policies regarding the discontinuance of additional precautions were in place; 13 hospitals (39%) discontinued precautions as soon as the patients were asymptomatic, and 19 hospitals (58%) required a delay of 24 to 72 hours with no symptoms. One hospital continued precautions until the end of the treatment for CDI. This hospital had the greatest percentage of positive test results (32% vs 12% for all other hospitals combined;  $P < .001$ ). No respondent continued additional precautions until discharge. With respect to the roommates of a patient with CDI, 19 hospitals (58%) reported testing roommates for *C difficile* toxin who are symptomatic and initiating additional precautions pending results. Two hospitals (6%) screen roommates only during an outbreak. The remaining 12 hospitals (36%) had no specific policy and procedure for screening roommates of patients with CDI.

Most hospital laboratories followed 1 of 2 CDI testing strategies; 23 hospitals (70%) tested liquid stools based on a clinician's order, and 8 hospitals (24%) tested all liquid stools submitted regardless of whether or not *C difficile* testing was requested. The remaining 2 hospitals (6%) tested liquid stools only when CDI was suspected; no physician order was required for testing. The testing strategy of all respondents was hospital-wide; no institution implemented a testing strategy that was dependent on the specific unit within the hospital. Twenty-two hospitals (67%) used a computerized patient information system to identify patients with a positive *C difficile* test or placed a marker on the patient's chart. The remaining hospitals had no specific

**Table 2.** Infection control measures used for patients with CDI in addition to routine practices (n = 33)

| Infection control measure | Inpatient (acute care) |                | Outpatient, n (%) | Rehabilitation wards, n (%) | Long-term care wards, n (%) |
|---------------------------|------------------------|----------------|-------------------|-----------------------------|-----------------------------|
|                           | ICU, n (%)             | Non-ICU, n (%) |                   |                             |                             |
| None                      | 0                      | 0              | 1 (3)             | 0                           | 0                           |
| Single room               | 29 (88)                | 27 (82)        | 9 (27)            | 11 (33)                     | 8 (24)                      |
| Cohort                    | 13 (39)                | 15 (45)        | 2 (6)             | 5 (15)                      | 4 (12)                      |
| Gloves                    | 33 (100)               | 33 (100)       | 19 (58)           | 13 (39)                     | 13 (39)                     |
| Gowns                     | 33 (100)               | 33 (100)       | 17 (52)           | 13 (39)                     | 13 (39)                     |
| Masks                     | 1 (3)                  | 1 (3)          | 0                 | 0                           | 0                           |
| Barriers used by staff    | 31 (94)                | 31 (94)        | 18 (55)           | 12 (36)                     | 12 (36)                     |
| Barriers used by visitors | 23 (70)                | 23 (70)        | 6 (18)            | 9 (27)                      | 8 (24)                      |
| Dedicated equipment       | 27 (82)                | 27 (82)        | 11 (33)           | 12 (36)                     | 10 (30)                     |



**Fig 1.** Number of liquid stools tested for *C. difficile*.

form of identification for patients with CDI besides the medical and/or nursing notes in the medical record.

In 2003, an average of 1600 tests were performed at each hospital (range, 20 to 4508) (Fig 1). The proportion of positive CDI assays ranged from 5% to 32% (median, 10%). Only 1 hospital in central Canada reported a proportion of positive tests > 30%.

Six different laboratory methods were used to detect *C. difficile* toxin in patient stool. Sixteen hospitals (48%) used only enzyme immunoassays (EIAs) to detect toxins A and B; 17 hospitals (52%) used other tests, including cytotoxin testing using tissue culture (12; 36%), EIA detecting only toxin A (6; 18%), or the Triage panel for toxin A and glutamate dehydrogenase (3; 9%). No hospital performed cultures for *C. difficile* or used latex agglutination. Fourteen hospitals (42%) reported a usual delay from specimen receipt to assay testing of < 24 hours; that is, the test was performed on the same day. An additional 14 hospitals (42%) reported that testing was performed between 24 and 48 hours after receipt of stool specimens. In 2 hospitals, the delay was longer on weekends than during the week. One hospital reported performing assays only twice a week.

Hospitals used 1 of 3 different products as their standard hospital-wide disinfectant; 24 hospitals (73%) used only quaternary ammonium compounds, 8 hospitals (24%) used accelerated hydrogen peroxide, and 1 hospital (3%) used an unbuffered hypochlorite

solution (1:10 bleach solution). The hospital with the highest percentage of positive CDI test results was the sole hospital that used bleach as its standard disinfectant. Nineteen (58%) hospitals did not change their disinfectant type or concentrations because of CDI. Of the 14 that did change, 10 (71%) changed the disinfectant for all cases of CDI, and the other 4 changed the disinfectant only during outbreaks. Nine of these 14 hospitals (64%) changed to bleach, 1 hospital (7%) increased the bleach concentration, and 4 hospitals (29%) switched to accelerated hydrogen peroxide.

In 2003, a total of 33 outbreaks were reported in 14 (42%) hospitals. One hospital (7%) reported 7 outbreaks; 1 hospital (7%) reported 5 outbreaks; 3 hospitals (21%) reported 3 outbreaks; 3 hospitals (21%) reported 2 outbreaks, and 6 hospitals (44%) reported 1 outbreak. The outbreaks resulted in 3 ward closures, all in the same hospital. Of the total number of the outbreaks reported by the hospitals, 26 (79%) occurred on medical or surgical wards. There were 4 outbreaks (12%) on hematology/oncology units, 2 outbreaks (6%) on long-term care units, and 1 outbreak (3%) on a hemodialysis unit. No outbreaks occurred in ICUs or pediatric units. One hospital noted “ongoing endemicity,” and 12 hospitals (36%) were unable to pinpoint outbreaks versus increased incidence on medical wards.

## DISCUSSION

This report presents the findings of the first survey of infection prevention and control practices and laboratory methods used by Canadian acute care hospitals to control CDI. Although contact precautions were used quite uniformly in the 33 hospitals participating in the study, considerable variation was found in terms of testing strategies, cleaning and disinfection protocols and products, and isolation practices, even though a standardized case definition for CDI was used by all participating hospitals during the 6-month prospective surveillance. Although our sample size is too small to

determine statistically whether the variation in practice correlates with the prevalence of positive stool tests or the number of outbreaks reported by the hospitals, it is interesting to note that the hospital with the highest percentage of positive test results used different infection control practices than any other hospital. It was the only hospital that used bleach as its regular hospital disinfectant, that inappropriately used masks as an additional precaution when a patient is identified as having CDI, and that continues precautions until the completion of treatment for CDI. These additional measures may reflect efforts to control a high rate of disease that has not responded to routine measures, or it may reflect the use of a more sensitive laboratory testing method for *C difficile*. This hospital used only 1 testing method for *C difficile*—cytotoxin testing using tissue culture. This assay requires technical expertise, is costly, and takes 24 to 48 hours to produce a final result; it does provide specific and sensitive results for *C difficile*.

There has been considerable interest in using disinfectants for the environmental control of *C difficile*, particularly in using bleach to clean the rooms of patients with CDI. Environmental contamination in hospitals and long-term care facilities has been reported in the literature for more than a decade<sup>15,20</sup> and remains a common problem.<sup>1,21,22</sup> Asymptomatic carriers represent an important hidden reservoir<sup>23-25</sup> and provide a source of substantial environmental contamination.<sup>25,26</sup> The combination of the tenacity of *C difficile* (which is spore-forming) and a contaminated environment sets the stage for frequent transmission within hospitals.<sup>26</sup>

Using bleach to clean the rooms of patients with CDI remains controversial.<sup>27</sup> The current guidelines from the Society of Hospital Epidemiologists of America and the Centers of Disease Control and Prevention for the prevention and control of *C difficile* recommend using a 1:10 hypochlorite solution for environmental cleaning of the rooms of patients with CDI.<sup>27,28</sup> In our survey, 1 hospital used bleach as its routine hospital disinfectant, and another 9 hospitals (27%) reported using bleach in the rooms of patients with CDI. Bleach is not commonly used for surface disinfection because it is toxic and highly corrosive.<sup>29</sup>

Recently published Canadian recommendations state that quaternary ammonium compounds remain effective disinfectants for *C difficile*, provided that all horizontal surfaces in the room and all items within reach of the patient are thoroughly cleaned, and that cleaning clothes and mop heads are changed frequently to limit contamination of the disinfection solution.<sup>29</sup> In our survey, 24 hospitals (73%) reported using a quaternary ammonium compound as the routine hospital disinfectant, although 10 of these hospitals

(30%) reported changing disinfectants for cleaning the rooms of patients with CDI.

Accelerated hydrogen peroxide has gained popularity recently, because it has been shown to inactivate *C difficile* spores within 15 minutes.<sup>30</sup> Although easier to use than hypochlorite solution, it is corrosive to some equipment and may not be appropriate for frequent cleaning, as is recommended for the rooms of patients with CDI. Eight hospitals (25%) reported using accelerated hydrogen peroxide as the routine hospital disinfectant, and another 4 (12%) reported using this product to clean the rooms of patients with CDI.

Appropriate management of CDI, including infection control management, requires timely access to sensitive diagnostic testing. Fewer than half of the responding hospitals had access to same-day testing, and in 2 instances only twice-weekly testing was available. In settings in which laboratory confirmatory testing is not immediately available, both clinical and infection management may be necessary on clinical suspicion of CDI, as opposed to delaying action until laboratory confirmation is available.

The surveyed hospitals reported mainly using 1 of 2 testing approaches: EIA for *C difficile* toxin or a tissue culture cytotoxin assay. EIA is significantly less sensitive than tissue culture cytotoxin assay, however.<sup>31</sup> Some of the intrahospital variation in CDI rates in Canada may be attributable to differences in the sensitivity of the diagnostic assays used in these hospitals. Practitioners in hospitals using an EIA testing method should be cognizant of its lower sensitivity and thus be prepared to either repeat testing when clinical suspicion of CDI is high or to manage even patients with a negative toxin EIA as though they have CDI.

No hospital in our survey reported using a culture method for detecting CDI, a method in use in some European centers.<sup>32,33</sup> Although both slower and more costly than toxin assays, culture testing has better sensitivity than either EIA or tissue culture cytotoxin assay, but considerably lower specificity.<sup>31</sup> Culturing of *C difficile* may have an added advantage in infection control, especially in outbreak management, by permitting both antimicrobial susceptibility testing of isolates and pulsed-field gel electrophoresis typing to characterize outbreak strains.

The prevention and control of CDI has been and continues to be difficult.<sup>11</sup> Although the evidence for use of a private room (and toilet) is based on observational data, it appears that this practice, in combination with contact precautions and special emphasis on environmental cleaning and disinfection, has become widespread in the control of CDI transmission.<sup>12</sup> Although providing a private room with a toilet is of primary importance in preventing the spread of CDI,<sup>22</sup> our aging hospital infrastructures may perpetuate the

overcrowding of patients in wards with multibed rooms and shared toilets. Limited housekeeping resources also pose a challenge.<sup>3,5</sup> Inadequate resources for infection control across Canada may have contributed to the CDI problem that we face today.<sup>3,4</sup>

The timing for the initiation of infection control precautions also is important. Current recommendations suggest that infection control precautions for *C difficile* should be implemented based on the presence of symptoms.<sup>28</sup> Only slightly more than half (55%) of our hospitals implemented precautions while awaiting toxin assay results. This is important because results may be delayed, especially over weekends or holidays. No outbreaks during the previous year were reported in the hospitals that implemented precautions based on the presence of symptoms. Precautions based on symptoms are of benefit if there is a false-negative toxin assay and/or if the diarrhea is not associated with *C difficile*.

Our study has some limitations. The 33 hospitals that completed the survey were all major university-affiliated acute care hospitals and cannot necessarily be seen as representative of all Canadian hospitals. As such, these results represent hospitals with larger, more established infection prevention and control programs. Second, we did not obtain information regarding antibiotic use or antibiotic stewardship, which has been shown to be the single most successful strategy for preventing the development of CDI,<sup>1,2,11-14</sup> nor did we assess the hand hygiene practices in these hospitals. In addition, we surveyed the infection control policies for the participating hospitals, not the actual practices in place. That policies are not always uniformly applied throughout a hospital can be expected. Finally, although we cannot draw specific conclusions from our results, it is likely that more variation in practices would have been found had smaller hospitals been included.

Despite its limitations, this study has provided some important insights into CDI prevention and control measures. Substantial costs are attributable to CDI in terms of patient morbidity and mortality, as well the increased financial burden on the health care system.<sup>4,35</sup> Hospitals must develop strategies to improve the adherence to infection prevention and control guidelines for patients with CDI. In addition, additional studies are needed to examine the correlation between infection prevention and control practices and the incidence of CDI, to help guide development of appropriate hospital policies. Given the importance of CDI, further research on control measures is urgently needed, especially in terms of environmental decontamination strategies.

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