A Report on

Lessons Learned Following a *Clostridium difficile* Outbreak in Acute Care

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Abbreviations/Definitions:

ABHS- alcohol based hand sanitizer

CBDHA -Cape Breton District Health Authority

CBRH -Cape Breton Regional Hospital

GBHC -Grace Bay Health Centre

CNISP- Canadian Nosocomial Infection Surveillance Program

HA-CDI -Hospital acquired *C. difficile* infection) definition used for CBDHA outbreak:

Confirmed Case AND

Onset of clinically compatible illness (CDI) in patient present in acute care facility for greater than or equal to 72 hours (whether formally admitted or not)

OR

Onset of clinically compatible illness (CDI) in patient who was present in acute care facility for greater than or equal to 24 hours (whether formally admitted or not) within the previous 4 weeks.

HCA-CDI -Healthcare associated *C. difficile* infection: CNISP

Patient's CDI symptoms occur in your hospital ≥ 72 hours after admission OR
CDI is seen in a patient who had been hospitalized at your hospital and discharged within the previous 4 weeks

IPCNS -Infection Prevention and Control Nova Scotia

CHICA NS- Community and Hospital Infection Control Association Nova Scotia

Executive Summary

In February, 2011, it became apparent that Cape Breton District Health Authority (CBDHA) was experiencing increased incidence of *Clostridium difficile* infections at their regional site and in March and increased activity was evident in at least three of their nine facilities. Cape Breton Regional Hospital, Glace Bay Hospital, and New Waterford Consolidated Hospital were the primary sites for increased incidence of the disease.

In response to the increase in cases, enhanced infection control measures were implemented in all hospitals which included isolating patients presenting with diarrhea and enhanced patient room cleaning. Nova Scotia Department of Health & Wellness, IPCNS infection control consultants made further recommendations which included the deactivation of bedpan spray wands and the introduction of an alternative sporicidal agent. Additional changes to practices were addressed in the areas of fecal waste management, cleaning protocols, environmental and equipment management, patient accommodation, and patient transfers. Visitor restrictions and personal protective equipment for visitors and staff were also implemented in all hospitals within the district. Finally, increased education to staff and visitors on personal protective measures, hand hygiene, and contact isolation were provided.

CBDHA maintained strong communication to all stakeholders by holding daily outbreak meetings and providing progress reports, both internally and to the Nova Scotia Department of Health and Wellness (NSDHW). Transparency in communication to the public was also evident with weekly updates being released to the media. Ongoing support in terms of infection control personnel was provided from the Nova Scotia Department of Health and Wellness (NSDHW), Capital District Health Authority, and Pictou County Health Authority.

The assistance from the Public Health Agency of Canada's *Canadian Field Epidemiology Program* was requested on behalf of the CBDHA, with two Field Epidemiologists subsequently mobilized to provide epidemiological support for the *C. difficile* outbreak.

The Field Epidemiologist's identified that from January 1st to May 6th 2011, this multi-site outbreak resulted in 64 confirmed CDI cases being diagnosed during this time period, with 49 cases (77%) classified as healthcare-associated *Clostridium difficile* (HA-CDI) cases. Eleven deaths were associated with this outbreak with an all-cause mortality of HA-CDI cases at 30 days post-diagnosis of 16.3 per 100 patients. Epidemiological data found that risk factors, including age, underlying health conditions, previous antibiotic (primarily fluorquinolones) and acid-suppressing medication use, and encounters to a healthcare setting were common among all cases. The NAP1 strain of *Clostridium difficile* was the predominant strain isolated. There is a discrepancy in data reported by the Field Epidemiologists compared to that provided by the Department of Health and Wellness and CBDHA as the data from the Field Epidemiology report was only up to May 6th, 2011 (prior to the outbreak being declared over May 27th, 2011) and some of the infections may not have been included because of specific outbreak case definitions.

Intent of the Report

Infection control consultants from IPCNS spent approximately 5 weeks on-site assisting the district infection control practitioners and district staff in managing the outbreak. This on-site presence allowed the consultants to cursory gauge the level of infection prevention and control oversight in other areas such as Sterile Reprocessing and Endoscopy departments, with general infrastructure challenges, and the degree of compliance of staff with infection prevention and control practices in general, regardless of the outbreak situation. Although this report is primarily focused on the lessons learned post- *C. difficile outbreak* in the Cape Breton District Health Authority, other notations of concern or recommendation may be made.

CBDHA is not unlike other district health authorities in the province and they experience similar challenges and adverse events. It is not intended to negatively highlight gaps in infection prevention and control at one district but rather to provide an opportunity for other district health authorities to take a preemptive and proactive role to prevent similar occurrences in their facilities.

Contributions to Successful Outbreak Response

Recognizing the significance of the increased activity and the need for additional resources, CBDHA requested such support from other district health authorities (DHAs) and the NSDHW. In addition to the extensive work conducted on site by the consultants from IPCNS there was a sincere effort on the part of other DHAs as well as infection control practitioners across the provinces to lend support.

As well, the ability to access field epidemiology experts, infectious diseases physicians, public health nurses, the provincial public health branch, Medical Officers of Health, and additional infection prevention and control expertise was valuable to extend the expert resource capacity at CBDHA. This included a significant commitment by a vendor to provide support for cleaning/ disinfection chemistries and timely education of Environmental Services staff.

CEO John Malcolm and the senior leadership team were committed to securing resources and ensuring the implementation of expert recommendations once an outbreak was identified. Daily outbreak team meetings with senior leadership, clinicians, and infection prevention and control experts provided a much needed forum for discussion and resolution of issues.

The CBDHA infection prevention and control team also provided steadfast dedication, working long hours, providing their expertise to minimize the impact to the patients and family of those affected by the outbreak.

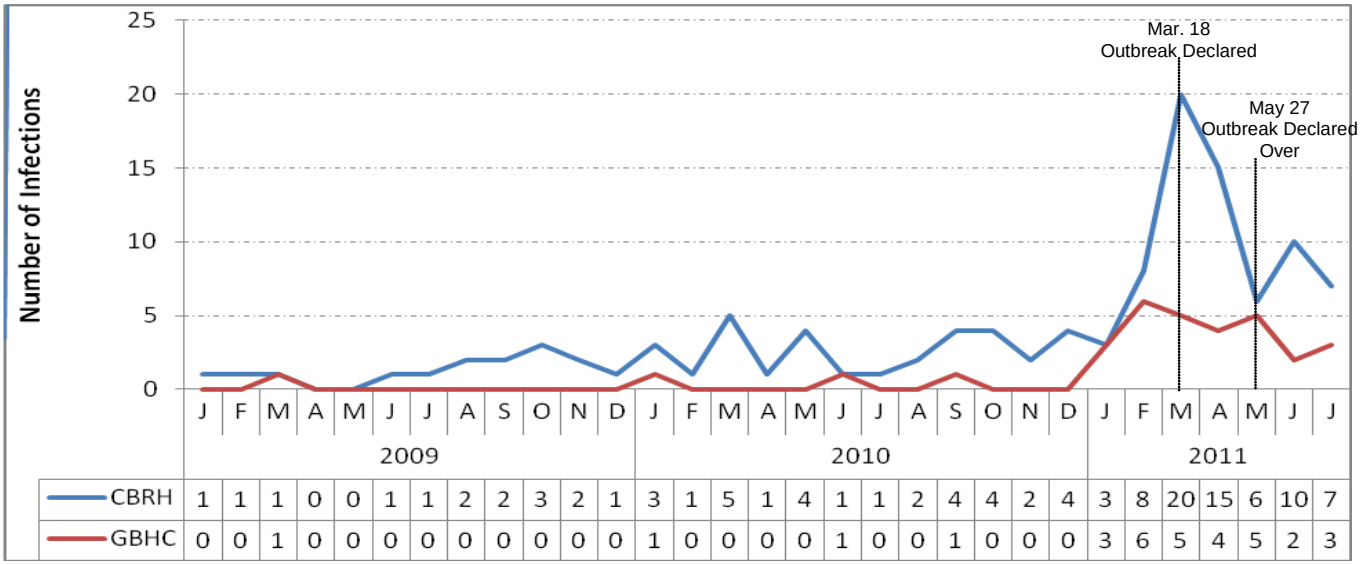
Epidemiologic Summary

Overall there were a total of 91 positive *C. difficile* Infections (reported in CBDHA from the beginning of 2011 to the end of the outbreak (May 27th, 2011), with most being reported from either CBRH or GBHC (n = 52 and n = 23, respectively). Please note: there may be discrepancy in data reported by the Field Epidemiologists compared to that provided by the Department of Health and Wellness and CBDHA as the data from the Field

Epidemiology report was only up to May 6th, 2011 (prior to the outbreak being declared over) and some of the infections may not have been included because of specific outbreak case definitions.

This was larger than the number of infections seen in 2009 and 2010, by both hospitals (Figure 1). Although CBRH had a higher number of infections than GBHC, the rates of hospital acquired infections (per 1,000 patient days) experienced in 2011 (up to August) were mostly higher in GBHC than CBRH (Figure 2).

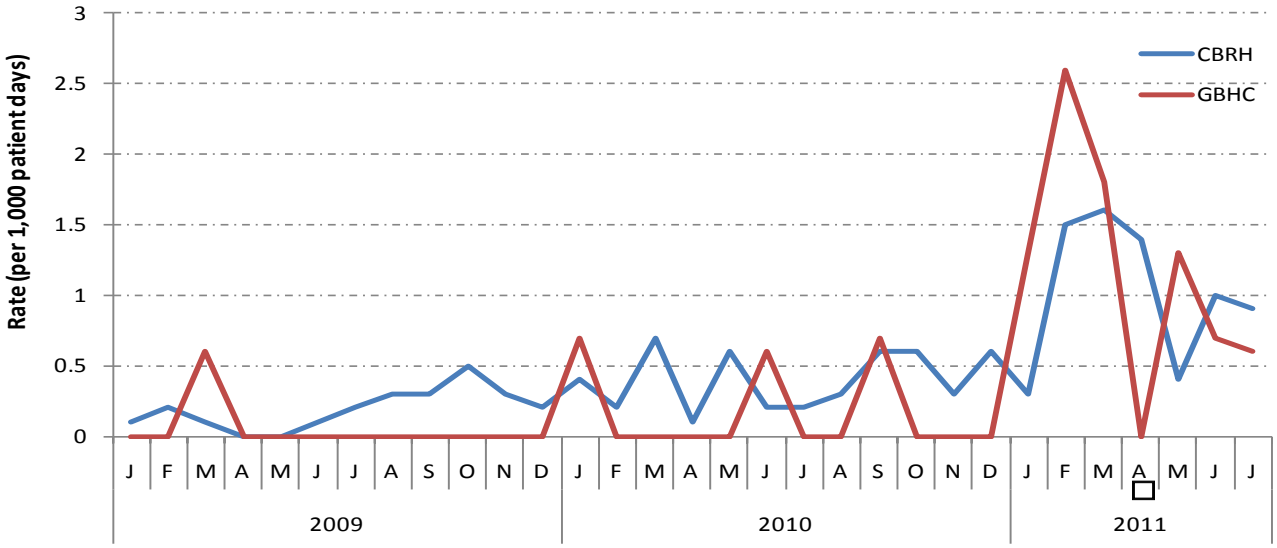
Figure 1 Number of *C.difficile* Infections Reported by CBRH and GBHC, Cape Breton, 2009-2011



	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J
	2009												2010												2011						
CBRH	1	1	1	0	0	1	1	2	2	3	2	1	3	1	5	1	4	1	1	2	4	4	2	4	3	8	20	15	6	10	7
GBHC	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	3	6	5	4	5	2	3

Source: Cape Breton District Health Authority, August 2011

Figure 2 Rates of Hospital Acquired *C.difficile* Infections (per 1,000 Patient Days) Reported by CBRH and GBHC, Cape Breton, 2009-2011



*** Data was not available for April 2011, as of time of report production**
Source: Cape Breton District Health Authority, September 2011

Strain typing of those specimens associated with the outbreak (met the outbreak case definition) indicated that 51% of the samples were identified as NAP1 strain (Table 1). However, NAP2, NAP4, NAP10 and NAP12 were also identified.

Table 1 Epidemic Typing of Specimens Collected from CBDHA, Feb. 18 – Jun. 22, 2011

"Sporadic" Strains	**13**	21%
NAP1	**31**	51%
NAP2	**4**	7%
NAP4	**5**	8%
NAP10	**1**	2%
NAP12	**3**	5%
Not typed (as of June 22/11)	**4**	7%
Total	**61**	100%

Source: Department of Health and Wellness, Population Health Assessment and Surveillance, September 2011. Culture and typing performed by Dr M. Mulvey, National Microbiology Laboratory, Winnipeg

Deputy Chief Medical Officer of Health, Department of Health and Wellness coordinated obtaining Field Epidemiologists from the Public Health Agency of Canada to assist in providing epidemiology support to the outbreak; the following is a summary of their findings.

Public Health Agency of Canada Field Epidemiologists Summary of Findings

In February 2011, an increase in the number of laboratory-confirmed *Clostridium difficile* cases was identified at one hospital within the Cape Breton District Health Authority (CBDHA). In the subsequent weeks, additional cases were identified in other hospitals and an outbreak of *C. difficile* was declared for the district on March 18th, 2011. Two field epidemiologists from the Canadian Field Epidemiology Program, Public Health Agency of Canada assisted in the subsequent outbreak investigation to provide a descriptive summary of the outbreak, review current infection control practices, determine possible transmission patterns and provide additional epidemiological support including determining criteria to declare the outbreak over and assessing causality of infection on 30-day mortality. This report summarizes the findings from these aspects of the investigation.

Outbreak case definitions were developed to confirm and classify cases. Using a standardized questionnaire, hospital electronic and paper charts were reviewed to collect data for the descriptive summary. A review of all case deaths was conducted to assess the degree to which *C. difficile* infection (CDI) contributed to mortality within 30 days of diagnosis. The assessment used the "Death attribution rules for Patients Infected with *C.*

difficile algorithm developed by Dr. Mark Miller and the Canadian Nosocomial Infection Surveillance Program (CNISP). To review current infection control practices, the Head Nurse of Infection Control for all hospitals within CBDHA was interviewed. To assess possible transmission patterns within hospitals, hospital records of patient movement were reviewed for all hospital acquired cases one month prior to diagnosis and common rooms were identified. To determine the criteria used to declare the outbreak over for each hospital and district, discussions were held between CBDHA, the Nova Scotia Department of Health and Wellness and CNISP.

A total of 64 laboratory-confirmed *C. difficile* cases, including 11 deaths, were identified from January 1st to May 6th, 2011. Seven of nine hospitals in CBDHA had confirmed cases, with the majority in Cape Breton Regional Hospital (64%, n=41), followed by Glace Bay Health Care (20%, n=13), New Waterford Consolidated Hospital (6%, n=4), Buchanan Memorial (3%, n=2), Northside General (3%, n=2), Inverness Consolidated Hospital (2%, n=1) and Harbour View Hospital (2%, n=1). The epidemiologic review does not include any cases identified after May 6th that occurred as part of the outbreak. In addition, as some cases were still hospitalized and receiving treatment at the time of the analysis, complete data on complications and outcome were not available.

A total of 49 cases (77%) were classified as hospital acquired, 10 cases as hospital associated and 5 cases as other acquired. Most hospital acquired and hospital associated cases had numerous risk factors for infection, including: increased age, previous exposure to a health care setting, prior antibiotic and acid-suppressing medication use, and underlying health conditions. Where prior antibiotic use was documented, fluoroquinolones were most commonly prescribed. When comparing other acquired cases to hospital acquired and hospital associated cases, there was a marked decrease in all the above risk factors, which may be in part due to the other acquired cases being of a younger average age and generally healthier.

Between January 1st and May 6th, 11 patients with CDI died. Four deaths were directly attributed to their *C. difficile* infection. In the remaining deaths, the outcome of the analysis was as follows:

- *C. difficile* contributed to three deaths; however, two of these deaths occurred greater than 30 days after diagnosis,
- Three deaths were unrelated to their *C. difficile* infection,
- One death was indeterminate.

This should be interpreted with caution as deaths occurring 30 days after CDI diagnosis are more difficult to assess. For the 1 indeterminate death, CDI causality cannot be determined with confidence.

At the time of this analysis, laboratory results were only available for 35 (55%) of cases. Of these, both NAP and non-NAP strains were isolated in this outbreak. The majority of isolates were NAP1 and were more prevalent in cases with documented complications, especially those that experienced relapse. Due to the limited available strain data, an analysis to assess differences in severity of NAP strains could not be completed for the outbreak as a whole.

As the outbreak progressed, infection control measures were modified and intensified. Contact precautions for staff and visitors were put in place, as well as visitor restrictions for all hospitals in CBDHA. The report "*A*

Report on Lessons Learned Following a Clostridium difficile Outbreak in Acute Care" refers to specific infection control guidelines, actions and recommendations pertaining to this outbreak.

Among the hospital acquired cases, 63% had inter-unit transfers and 14% had inter-facility transfers. Double occupancy rooms, where cases occupied the room concurrently or sequentially, were identified in both Cape Breton Regional Hospital and Glace Bay Health Care. However, the limited laboratory results available (55%) at the time of our analysis could not definitively suggest that patient movement increased the burden of illness in this outbreak.

Three criteria were agreed upon to assist in declaring the outbreak over in conjunction with continued infection control practices and surveillance: (1) comparison to National and Atlantic region CDI incident rates in patient days, (2) comparison of April rates to the individual hospital's respective baseline CDI rates in patient days and (3) return to below-outbreak threshold values (for wards/units with greater than or equal to 20 beds, 3 cases of nosocomial CDI identified on one ward/unit within a seven day period or 5 cases within a 4 week period.

Recommendations:

- Nova Scotia is currently taking action to make CDI notifiable under public health legislation, and designing the guidelines for CDI surveillance, as well as case and outbreak management, for both public health and the infection prevention and control programs. It is encouraged that these guidelines include clear but collaborative roles and responsibilities for public health and the acute and continuing care sector as well as standard case definitions for notification and reporting. Furthermore, to assist with outbreak identification, previous baseline CDI rates for hospitals in the province would be beneficial to have as a resource.
- It is encouraged that infection control resources are continued to support ongoing audits and rounds of all hospital sites, surveillance and ongoing education on hospital acquired infections.
- An observation with the current computerized system is that it only contains laboratory results from the hospital, and not results from Queen Elizabeth II Health Sciences Centre or the National Microbiology Laboratory. As CDI becomes reportable in this province, it is encouraged that a self-directed system be available when obtaining these laboratory results.
- During an outbreak, it is encouraged that patient transfers be minimized to prevent transmission.
- It is encouraged that timelines and procedures for acquiring numerator and denominators for case counting be acquired in a timely manner in order to monitor hospital acquired CDI cases.

Public Health

Outbreaks or diseases occurring more frequently than expected are reportable to Public Health under the Health Protection Act. The role of local Public Health in outbreaks is defined in the Communicable Disease Manual, Outbreak Chapter and may vary depending upon the facility and circumstances. The role of Public Health in the CBDHA *C.difficile* outbreak included the coordination of obtaining Field Epidemiologists from the Public Health Agency of Canada to assist in providing epidemiology support to the outbreak. Additionally, local Public Health nurses in CBDHA provided education to health care staff within the facilities regarding

C.difficile. Public Health nurses in CBDHA met daily with the facilities and supported outbreak management as necessary for each facility.

Infectious Diseases

A review of the charts of patients with *Clostridium difficile* infection that expired was undertaken with respect to treatment. In these patients, treatment recommendations were in keeping with the standard of care. A review of the treatment of other patients was not done.

The local CBDHA infectious diseases consultant was available to give advice and guidance in the treatment of patients with CDI. However, it is important to reemphasize the appropriate management of CDI so that all physicians will be aware of current guidelines.

Areas for Improvement

Although substantial efforts and strategies were employed to get the outbreak under control, there were some key areas that could be improved upon, based on observations obtained during audits, walk-abouts, conversations with staff, discussions during the Outbreak Team meetings, and through data provided by the field epidemiologists' work.

Infection Control Program Infrastructure & Capacity

The Cape Breton District Health Authority provides acute care, continuing care, and programs and services through its hospitals, clinics and continuing care facilities. The District has a staff of approximately 3,900 health care providers and 270 hospital and community based physicians to provide primary, secondary and tertiary care to about 130,000 people. In total, the District has 466 Acute Care beds and 207 Veteran and Continuing care beds. At the time of the outbreak, the infection prevention and control (IP&C) program was staffed with 3.5 FTEs (which included 0.6 FTE manager) who were required to provide coverage to 8 hospitals, 1 long term care facility, and one facility that was dedicated for continuing care for veterans and rehabilitation. These facilities are geographically spread out across three counties: Cape Breton County, Northern and Central Inverness County and Victoria County. One full-time infection control practitioner (ICP) fulfills the role of team leader for the program as well as sharing in the management of the day-to-day IP&C concerns of the district.

The resource capacity and/or the structure of IP&C program compromised the ICPs' ability to manage a significant outbreak situation as well as maintain the regular activities of their program. Staff acknowledged an inability to increase their visibility on the units and to perform regular auditing (hand hygiene, infection control practices, environmental cleaning) and IP&C education to the staff and physicians. As well, there was some degree of "working in siloes" thus the program struggled to function as a district-based, supportive

program. It was evident that practices varied across the various facilities i.e. waste management, quality indicator processes in the sterile reprocessing department, etc.

The field of IP&C is a dynamic and ever-changing one with new evidence emerging regularly which informs best practice decision-making. Additionally, within Nova Scotia there is a well-connected professional network of district-based and continuing care-associated ICPs (CHICA NS) that share knowledge and benchmark practices. The APIC/ CHICA-Canada Professional Standards describe a certain level of individual competence in the professional role as ICPs strive through education, training, and certification. Professionals are expected to incorporate these standards as appropriate to their role and practice setting. There is a responsibility on the ICP to identify, acquire and maintain current knowledge and skills in the area of infection prevention and control. There appeared to be a lack of opportunity and/or commitment and facilitation to ensure that participation in educational and networking opportunities occurred for the ICPs.

The principal functions of an effective IP&C program are to protect the patient, visitors and the healthcare worker and to ensuring sustainability of healthcare delivery by:

- performing surveillance appropriate to the institution, clinical services provided and accepted regional and national standards
- ensuring critical data and information, including surveillance data, is managed and analyzed and communicated to appropriate stakeholders in a timely manner;
- establishing and maintaining current evidence-based policies and procedures;
- directly intervening to interrupt and control transmission of infection; and
- educating and training healthcare providers on how to implement best practices.

Additionally, the district needs to be inclusive of the IP&C program in addressing antibiotic usage patterns, advice on product procurement and evaluation, facility design and renovation, outbreak management, coordination with safety, and other quality assurance initiatives. In order to ensure that all of the above functions can occur, investment in education, training, and the assurance of “strong and validated voice at the table” for the ICPs is needed. There was initial concern that the district did not fully appreciate the complexity of the outbreak and/or the role and authority of the ICPs, and as a result, delays in fully implementing IP&C interventions occurred. At times, the ICPs appeared to lack legitimate authority to implement certain processes sooner that may have mitigated additional transmission i.e. cohorting, patient transfers, waste management, meal deliveries, selection of sporicidal disinfectant.

Surveillance: Outcome & Process

Surveillance, for healthcare-associated infections and other adverse events is considered the most important data-management activity for IP&C programs. Surveillance based on systematic data collection to identify infections, subsequent analysis of data and timely dissemination of results to persons who require the data to make improvements should be well-established and meeting the operational needs of the district and ensuring patient safety is maintained.

Outcome-oriented

At the time of the outbreak, it was noted that outcome surveillance occurred in a very siloed approach with each ICP responsible for infection-specific surveillance for all sites, making it difficult to ascertain clusters and increased incidence in facilities under one's purview.

Analysis and reporting of infection case data should be done on a regular basis (e.g., monthly, quarterly, annually) to detect trends. CBDHA reports were eventually collated but this occurred fairly retrospectively with data captured on non-shared drives in the interim. ICPs therefore did not have immediate access to data from other sites in the district. It took a considerable period of time, in the midst of the outbreak, before accurate surveillance data was in a format that could be analyzed according to time, person, and place.

Process-oriented

While on-site, IPCNS infection control consultants and outside district ICPs conducted numerous audits for Environmental Services and infection control practices i.e. dedicated equipment, hand hygiene, medical device reprocessing. It was acknowledged that, due to resource issues and technical expertise, particularly in the area of reprocessing, ICPs were unable to conduct audits of practice/process with any degree of regularity. This observation speaks to the resource capacity for coverage as well as the need for ongoing education and assurance of competencies.

Infrastructure & Equipment

As with many hospitals in Canada, ageing buildings can compromise the ability to ensure effective infection prevention and control practices, particularly in the area of environmental cleaning. Observations from several facilities in CBDHA revealed deteriorating infrastructure that made it very challenging, if not impossible, to clean and disinfect appropriately i.e. missing floor tiles, exposed wood and particle board on high-touch patient room surfaces, and other non-intact surfaces. Current selection of material for surfaces also presented some challenges with textured or porous materials used i.e. textured wall boards, cork, and porous fabric-covered chairs. As well, physical/spatial layout of rooms could contribute to potential for contamination of high touch environmental surfaces and patient care supplies i.e. hopper in close proximity to clean supplies.

Patient care equipment such as commode chairs, raised toilet seats, and therapeutic chairs can also present a challenge for environmental services and nursing staff to clean and disinfect. Porous surfaces (cloth fabric), intricate grooves and mesh on reusable equipment and items requiring maintenance to dismantle impact the ability to ensure appropriate and timely cleaning and disinfection. IP&C can provide insight into the ability to clean and disinfect various types of equipment if they are engaged in the procurement process. Environmental services should be involved for similar reasons to ensure staff resources are adequate to address cleaning and disinfection needs as well as compatibility issues with the various cleaning chemistries.

Spray wands, a common tool used by nursing staff to manage bedpan and commode rinsing, were operational in the district however there is potential for contamination of both healthcare providers and environment during use. Waste management strategies that address cross-contamination and are communicated and implemented at the frontline nursing level are important processes to have established. Additionally, physical access to hoppers in soiled utility rooms was often compromised. This may have precipitated alternative

approaches to waste management that resulted in unnecessary environmental contamination i.e. use of multi-patient toileting facilities for waste discarding. Some staff indicated that they rarely, if ever, use the hopper for discarding waste and there was a degree of resistance among staff to adjust practices and some degree of hesitance to promptly implement necessary practice changes.

Access to alcohol-based hand sanitizer (ABHS) was evident throughout the facilities however, given the sporulating nature of *C. difficile*, hand washing with soap and water is the preferred means for hand hygiene. As with many healthcare facilities, adequate access to *dedicated* hand hygiene sinks in patient care areas was limited. Staff were instructed to perform a hand rub with ABHS and then seek out an opportunity to perform a proper hand wash. During the outbreak, this issue was being addressed to the best of the district's ability given that preexisting plumbing infrastructure was, in certain areas, somewhat prohibitive to install sinks without major renovations to the unit or impedance of fire exit and egress routes.

Environmental Services

Environmental Services (ES) staff play a crucial role in prevention transmission. With *C. difficile* considered a hardy environmental contaminant due to its ability to generate spores, the focus on cleaning and disinfection processes is paramount. Education, policies and procedures, auditing of practices, and communication are needed during outbreak and non-outbreak times. Auditing of processes and having well-established policies and processes may have addressed concerns related to the use and application of household bleach as a sporicidal agent i.e. cleaning processes, ensuring adequate wet contact time, and work flow.

Cleaning and disinfection procedures need detailed checklists or protocols, with staff well-versed on the procedures during both outbreaks and non-outbreak times. Environmental service audits had not been completed regularly prior to the outbreak and audits completed during this time identified some concerning practices.

Environmental cleaning practices, left unmonitored, can lead to ineffective practices that in turn result in ongoing potential for indirect environmental transmission of *C. difficile*. Although use of sodium hypochlorite (bleach) was implemented early in the outbreak to address spores, it was discovered later that the cleaning/ disinfection process was not in accordance with best practice. Bleach should not be considered a cleaning solution, but rather a disinfectant, as it is inactivated by organic material. Another issue associated with the bleach use was the difficulty in ensuring adequate wet contact time due to the lack of viscosity of the solution on non-porous bathroom fixtures.

It was frequently observed that food and/or beverages were stored on the cleaning carts of environmental services staff. Although not necessarily a risk for transmission to patients, this practice puts ES staff at risk for contracting any number of communicable diseases, particularly those with fecal-oral transmission characteristics and therefore is also an occupational health concern.

Infection prevention and control staff have considerable expertise in selecting and auditing environmental cleaning products and processes. A collaborative relationship between ES and IP&C is essential to ensure the best possible products are used and practices are implemented. It appeared that IP&C had limited influence in

selection of an appropriate product and in ensuring appropriate processes were in place. Education to ES staff was significantly delayed until first week of April, well into the outbreak.

Patient Accommodation and Transfer

In the event of an outbreak, the goal is to contain the organism to prevent further transmission and illness. Although it was deemed in the best interest of infected patients to transfer to their home hospital, when taking into account the length of stay of some cases and the laboratory collection date of the first positive test, results suggest that patient movement may have assisted in the transmission of this outbreak. The epidemiological study, conducted by field epidemiologists from PHAC, identified numerous "hotspot" rooms were identified at the two hospitals with the greatest number of cases, and may have contributed to the overall burden of illness in the district. 63% of hospital-acquired cases had inter-unit transfers, with a range between 2 and 11 transfers among these patients.

Cohorting of patients during outbreaks is an acceptable practice and one that is necessary at times when capacity to isolate infected patients in a private room has been reached. Although concern was expressed about placing two infected cases together without knowing the strain, cohorting would still have been preferable to trying to accommodate isolated patients with non-isolated patients.

Outbreak Management Team

An outbreak was declared on February 23rd, 2011 however an outbreak management team was not officially struck until March 3rd. The IP&C team did meet regularly to discuss outbreak measures however the extent of the outbreak warranted a more district-wide management approach. It was at this time that more additional measures were decided upon and implemented including twice daily cleaning, use of disposable dishes, increasing visibility of ICPs on the units, increased monitoring of clinical symptoms by ICPs, and further instructions for ES staff when using bleach. It should be noted that disposable dishes is not an evidence-based practice and the use of them was discontinued midway through the outbreak.

The outbreak team consisted primarily of senior leadership and physicians. Infection prevention and control, at times were represented by the physician advisor or manager. This occurred less frequently as the outbreak progressed. An outbreak team should ideally include representation, as felt appropriate to the situation, from the multiple stakeholders involved in the outbreak. This may include but is not limited to nursing managers, physicians, administration, Occupational Health, Public Health, microbiology laboratory services, communication/media relations, environmental/housekeeping services, allied health services (eg. nutrition, rehab, pharmacy, diagnostic imaging), etc.

Antibiotic Stewardship & Medication Considerations

Infected cases had a thorough review of the prescribed medications, including antibiotics and acid-suppressing medication. Similar to many hospitals a formal antibiotic stewardship program is not in place however this does not necessarily imply that the antibiotics were inappropriate for the clinical presentation or that had they received a different antibiotic, that they wouldn't have developed CDI.

According to the data from the field epidemiologists' investigation, the HA-CDI, HCA-CDI, and other-acquired cases had antibiotic use three months prior to diagnosis documented, with the HA-CDI cases reporting the highest proportion at 86%. Varying proportions of fluoroquinolone use was reported in those with an antibiotic history, with HA-CDI cases at the highest at 95%. Moxifloxacin was the most commonly prescribed antibiotic, followed by ciprofloxacin. Among HA-CDI, 45% of cases also had a documented history of 2nd or 3rd generation cephalosporin use in the three months prior to diagnosis, with ceftriaxone being the most common among these cases. It has been found in previous studies that these antibiotics do carry a higher risk for development of CDI.

It has been observed in studies that acid-suppressing medication may increase the risk of CDI by impairing the secretion of gastric acid which normally helps to protect a person from infection with intestinal pathogens.. In our observations, the percentage of acid-suppressing medication (e.g. proton pump inhibitors) was different in the three groups, with HA-CDI being the highest at (53%). HA-CDI cases also had the highest proportion of patients that had previous gastrointestinal surgery or procedure in the past month (24%) or had a non-malignant GI pathology (24%) which are known risk factors for acquiring CDI. However, HCA-CDI had the highest proportion of patients with genitourinary surgery in the past month (30%).

Although difficult to implement and modify the prescribing behaviours of physicians, an antibiotic stewardship program can improve the antibiotic use within an institution which has many benefits beyond reduced risk of CDI including reducing cost and antibiotic resistance.

Lessons Learned: Recommendations

Infection Control Program Infrastructure & Capacity

At the time of the outbreak there were 3.5 FTE ICP positions responsible for overseeing infection control for the whole DHA, with 0.6 of one of the positions used to fulfil manager responsibilities.

1. Develop the IPAC program that meets the mandate and goal of decreasing the risk of health care-associated infections and improving health care safety. This should be in line with the District mandate and reviewed yearly with a multidisciplinary infection prevention and control committee. It should include annual goal-setting, program evaluation and ensuring that the IPAC program meets current legislated standards and requirements as well as the requirements of the facility.

Guidelines and practice standards recommend that healthcare facilities have trained ICPs and resources to implement the IPAC program that are proportional to the size, complexity, case mix and estimated risk of the populations served by the health care facility. The minimum recommendations for staffing should not be based exclusively on bed numbers. Guidelines for the required ratio of ICPs to patient beds will vary according to the acuity and activity of the health care setting, geographic considerations (ie. multiple sites), and the volume and complexity of the ICP's work. PIDAC (2011) Best Practices for Infection Prevention and Control Programs in Ontario in All Health Care Settings outlines specific recommendations for staffing ratios based on a variety of literature sources:

a) a minimum ratio of 1.0 FTE ICP per 115 acute care beds;
b) a minimum ratio of 1.0 FTE ICP per 100 occupied acute care beds if there are high risk activities (e.g., dialysis);
c) it is recommended that an additional ratio of 1.0 FTE ICP per 30 intensive care beds be considered where ventilation and hemodynamic monitoring are routinely performed;
d) 1.0 FTE ICP per 150 occupied long-term care beds where there are ventilated patients, patients with spinal cord injuries and dialysis or other high acuity activities; and
e) 1.0 FTE ICP per 150-200 beds in other settings depending on acuity levels

2. The District has increased ICP FTE position by 1.5; however it should continue to increase the FTE compliment to meet the needs of the IPAC program.

Infection Prevention and Control is rapidly changing and ICPs must remain current with an expanding knowledge base. PIDAC (2008) Best Practices for Infection Prevention and Control Programs in Ontario in All Health Care Settings recommends that the ICP must acquire and maintain current knowledge and skills in IPAC and epidemiology through continuing education relevant to their professional practice and CBIC recertification every five years. Infection control professionals themselves have a responsibility to achieve this along with the support from the administration and have a job description which requires continuing education. APIC/CHICA-Canada Infection Prevention, Control and Epidemiology Professional and Practice Standards reflect the expectations, values, and priorities of the profession. It recommends that ICPs acquire and maintain current knowledge and skills in the area of infection prevention, control and epidemiology including completing a basic infection prevention and control training course within the first 6 months of entering the profession and becomes certified in infection prevention and control when eligible.
The ICP maintains a knowledge base of current IPAC information through peer networking, internet access to published literature, attendance at professional meetings including, as a minimum, annual attendance at an IPAC-related conference, and membership and time to participate in the Community and Hospital Infection Control Association – Canada (CHICA-Canada), including local chapter activities.

3. Require all ICPs to obtain Certification in Infection Control (CIC®), within two to five years of hire. This should be included in the job description.
4. Ensure that ICPs maintain their knowledge and skills through continuing education relevant to their professional practice and recertification in infection control every five years.
5. Facilitate ICPs' active participation in professional activities at the provincial and national levels of CHICA NS and CHICA Canada.
6. Increase visibility of ICPs on their respective units. Daily rounds will enhance relationships between infection control and the clinical unit.
7. Conduct regular and ongoing educational programs for healthcare providers (including volunteers, family members and students) to reinforce current best practices of infection prevention and control, emphasizing the importance of hand hygiene.

Surveillance: Outcome & Process

A large proportion of hospital acquired infections are preventable and the scientific literature has established that incorporating surveillance systems into infection prevention and control activities are a means to reduce the frequency and allows the ICP to track them and respond in a timely manner. According to PIDAC *Best Practices Document for the Management of Clostridium difficile All Health Care Settings May 2010* Each facility should establish a mechanism for counting and keeping track of the number of confirmed cases of CDI acquired within the facility and maintain a summary record. Infection Prevention and Control should review and analyze this data on an ongoing basis to identify any clusters. This record should be submitted as a report to the Infection Prevention and Control Committee and facility administration on a regular basis.

Infection Control Professionals must be able to interpret HAI rates so that they can identify areas where improvements to infection prevention and control practices are needed to lower the rate of infection, or to evaluate where preventive interventions have been effective in reducing the risk of infection. Interpreting the meaning of a rate of infection requires a close working knowledge of how one's surveillance system operates and of the changing risks of infection in one's facility. *Best Practices for Surveillance of Health Care-Associated Infections in Patient and Resident Populations* (2008) recommended best practice to have a colleague review HAI rates and check their accuracy prior to any interpretation of the rate.

Outcome surveillance is important in all health care facilities to identify HAI infections and ensure appropriate management and precautions are in place. Guidelines recommend that ICPs preforming infection surveillance must have access to all data and information systems required to perform these activities (e.g., laboratory results, admission records, client/patient/resident medical records, imaging results). This should include access to computerized databases that are required for accurate data and analysis of the infections along with easy access by all the IPAC team members.

PIDAC (2008) Best Practices for Infection Prevention and Control Programs in Ontario in All Health Care Settings recommends that results of process and outcome surveillance must be analyzed and reported back in a timely fashion; a plan for improvements, including organizational accountability, must be developed by the targeted area in conjunction with Infection Prevention and Control based on the results of surveillance.

Outcome-oriented

8. Review and revise surveillance practices for data collection, collation, analysis, and reporting to ensure timely and efficient identification of trends can be detected. Ideally, surveillance should be facility-based i.e. each ICP conducting surveillance of hospital acquired infections in the facilities they are responsible for.
9. Develop a process to store data so that it can be accessed and reviewed by ICPs in the various sites. Consistent documentation storage on a secure shared drive will facilitate this process.
10. Ensure the use of line listing occurs at the outset of an outbreak to better monitor cases, patient movement, and trends.
11. Ensure reporting of surveillance information to the involved services/programs and hospital administration in a format that is easily understood.

12. Consider reporting surveillance data as part of the hospital score card for quality and patient safety on the public web site in an understandable and easy to access format. This will improve transparency and confidence in the hospital.

According to PIDAC (2008) Best Practices for Infection Prevention and Control Programs in Ontario in All Health Care Settings, process surveillance (i.e., ongoing audit of practice) is done to verify that procedures and/or standards of practice are being followed and an action plan is in place to improve practice. One of the advantages of process audits is that the feedback given to providers is immediate. Process audits are based on validated evidence that has been demonstrated to improve outcomes. A plan for improvement, including organizational accountability, should be developed by the audited area in conjunction with IPAC, based on the results of the audit.

Process-oriented

13. Ensure Infection control practitioners perform ongoing audits (hand hygiene, adherence to additional precautions, environmental, and construction-site audits) and daily rounds of all hospital sites, either in person or by phone. Regularly scheduled visits to rural sites will increase visibility and provide opportunities to deliver targeted education to healthcare staff. Use of technology may assist in virtual visits to more remote rural sites when travel is difficult.
14. Provide opportunities for ICPs to expand their technical expertise, particularly in the area of reprocessing and construction/ renovation-related auditing. Gaps in knowledge should be identified and a plan developed to facilitate closing the knowledge gap.
15. Outbreaks should be managed by a multidisciplinary team that includes the ICP team. Delegate legitimate authority to the ICP to implement prompt outbreak management measures.

Infrastructure & Equipment

Healthcare settings should have policies that include the criteria to be used when choosing furnishings and equipment for patient/resident care areas and infection control should be involved. A process must be in place regarding cleaning of the healthcare environment that includes choosing finishes, furnishings and equipment that are cleanable, ensuring compatibility of the healthcare setting's cleaning and disinfecting agents with the items and surfaces to be cleaned, and identifying when items can no longer be cleaned due to damage.

16. Ensure Infection Prevention and Control has input in product procurement and evaluation, coordination with safety, and other quality assurance initiatives. It is imperative that they be involved at all stages of facility design and renovation and have the authority to halt projects if there is a risk to client/patient/resident or staff safety. Selected finishes should be able to withstand frequent exposure to hospital-approved disinfectants, be water impermeable and easily cleaned.
17. Non- intact furnishings and surfaces indentified by staff and through environmental audits should be repaired or replaced.

PIDAC *Best Practices Document for the Management of Clostridium difficile All Health Care Settings* (2010) recommends that commodes and bedpans must be handled very carefully to reduce spread of contamination with *C. difficile* spores from the commode/bedpan to the environment:

18. Ensure that:
    a) Commode chair is dedicated to the patient/resident;
    b) Commode is cleaned and disinfected whenever the room/bathroom is cleaned;
    c) When precautions are discontinued, dedicated commodes and bedpans are cleaned and disinfected before use with another patient/resident;
    d) Items used to clean the bathroom of a patient/resident with CDI must be dedicated to that bathroom and discarded once Contact Precautions are discontinued (e.g., toilet brush)

Sluicing and bedpan sprayers cause a high level of aerosol and subsequent contamination of the environment and the health care worker. (Alfa, 2010). Recent outbreaks in Ontario and Quebec have implicated the aerated spray wands as being a source of contamination. Bedpan flusher/disinfectors will ensure bedpans are cleaned and disinfected and safe to handle by staff after patient/resident use. They will also limit the amount of exposure of health care workers to body fluids and diminish the opportunity for bacterial growth. This equipment is optimal, however cost and work flow must be considered.

19. Ensure removal or decommissioning of spray wands in patient bathrooms and soiled utility rooms. It is acknowledged that CBDHA immediately disconnected the taps of the wands upon receiving this recommendation from IPCNS.

20. Develop and enforce a strict process for bedpan/ commode waste management to prevent further splashing and contamination of the environment, The process should utilize the soiled utility rooms or consider alternative management strategies that do not result in unnecessary environmental contamination of patient's toileting room. Installation of bedpan flusher/ disinfectors may be considered a viable alternative.

Effective hand hygiene is essential to limit the spread of C. difficile. Meticulous hand hygiene with either alcohol-based hand sanitizer (ABHS) or soap and water is recommended however soap and water is theoretically more effective in removing spores than ABHS.

21. Dedicated hand washing sinks should be available for staff to wash their hands. Hand hygiene should not be carried out at a patient sink as this will recontaminate the health care worker's hands. A plan should be developed in consultation with nursing staff and ICPs to determine the most appropriate locations for hand washing sinks to ensure they correlate with work flow practices.

22. Audit and observe meticulous hand hygiene with either soap and water or alcohol-based hand sanitizer (ABHS). Soap and water is theoretically more effective in removing spores than ABHS but if a dedicated sink is not immediately available ABHS is a reasonable alternative.

23. Provide education to staff and patient's on the need and procedure to be used for hand hygiene (ie. The 4 moments for hand hygiene).

Environmental Services

C. difficile contaminates patient care equipment and devices through fecal shedding or through the contaminated hands of patient or healthcare provider. The ability of *C. difficile* to survive on environmental surfaces demands adherence to recommended measures to prevent cross-contamination. Ongoing transmission of *C. difficile* may be a marker for poor adherence to environmental decontamination and other infection prevention measures. The infection control team should observe personnel and measure adherence to appropriate healthcare practices, especially when ongoing transmission occurs, in order to identify any breaches in infection prevention practice. *C. difficile* spores can persist for months in the healthcare environment and be transmitted to patients during this time.

PIDAC Best Practices for Environmental Cleaning for Infection Prevention and Control in All Health Care Settings (2009) recommends that products used for cleaning and disinfection must be approved by those responsible for product selection, an individual from environment services (ES), Occupational Health and Safety and by an individual with infection prevention and control

Environmental Services is responsible to ensure that the quality of cleaning maintained in the health care setting meets appropriate infection prevention and control best practices. The responsibility for ensuring that the standardized cleaning practices are adhered to lies not just with the person performing the task but also with the direct supervisor and management of the department or agency providing the cleaning service. It is important to incorporate elements of quality improvement into the program, including monitoring, audits and feedback to staff and management.

Monitoring should be an ongoing activity built into the routine cleaning regimen. Periodically, monitoring should take place immediately after cleaning, to ensure that the cleaning has been carried out correctly and to an appropriate standard. Data from monitoring should be retained and used in trend analysis and compared with benchmark values that have been obtained during the validation of the cleaning program.

Checklists and audit tools will assist supervisory staff in monitoring and documenting cleaning and disinfection. Feedback of results to ES staff has been shown to increase motivation and engagement with resulting improvements in cleaning scores. Auditing the cleanliness of the health care setting periodically and whenever changes to methodologies are made is essential to ensure that achievable cleanliness standards are maintained and to ensure consistency of standards throughout time in changing circumstances.

24. Ensure continuance of environmental audits. These should be carried out using a standard checklist and all audit results should be documented and analyzed. Audit results should be shared and reviewed with environmental services staff as part of ongoing professional development.
25. Engage IPAC in the selection and purchase of cleaning and disinfectant products. A system that utilizes automated dispensing/ dilution technology may streamline the process of mixing for staff eliminating any room for error with dilution ratios. All environmental services staff should receive in-depth education of both the cleaning chemistries they are using and the best practices for cleaning and disinfection.

26. Develop detailed checklists for environmental services staff to use during outbreak and non-outbreak times.
27. The proper cleaning of a *C. difficile* room involves twice daily cleaning and disinfection using a hospital approved cleaning and disinfection agent. The timing of the cleaning should be spaced as much as possible to improve the effectiveness of this process. A sporocidal agent should be used twice daily in the patients bathroom.
28. If an outbreak is suspected or confirmed switching to a sporicidal agent should be considered and used throughout the rooms of patients with suspected or confirmed CDI. It is important to note that bleach is not a cleaning agent and therefore if this is the selected sporicidal agent, cleaning must still be done using a compatible approved hospital cleaning and disinfection agent prior to application of bleach (this applies to # 26 above).

Patient Accommodation and Transfer

Patients should be assigned to a private room with a bathroom that is solely for use by that patient. When private rooms are of limited availability, patients who are fecally incontinent should preferentially be assigned to those private rooms. If a private room is not available, the infection control team should assess the risks and work with the patient care team to determine the best patient placement options (e.g., cohort with another patient diagnosed with CDI and no other discordant organisms, or keeping the patient with an existing roommate). If both patients have CDI and are cohorted, once the diarrhea stops for one person, that patient, if possible, should be transferred to a clean room.

C. difficile does not preclude a patient from being transferred within the healthcare system when medically appropriate provided that the unit/department/facility is able to comply with infection control requirements for accommodation, along with infection control resources to oversee precautions. Ideally, minimizing transfer will help to minimize the degree of environmental contamination.

29. When otherwise unexplained new onset of diarrhea occurs, those patients should be immediately placed on contact precautions while awaiting investigations to determine the cause.
30. Make every effort to minimize the amount of in-house and between-site transfers of symptomatic, isolated patients.
31. During an outbreak, it is strongly recommended not to manage patients with confirmed *C. difficile* in the same room as patients who do not have the infection.
32. A single room with dedicated toileting facilities (i.e., private bathroom or individual commode chair) is preferred. In instances where a patient is unable to be accommodated in this manner, priority should be given to patients who are fecally incontinent. If a symptomatic patient is in a multi-bed room, the patient should be provided a dedicated commode chair which must be emptied in a dedicated site (i.e. soiled utility hopper, bed pan flusher/disinfector) to avoid contamination of the environment. The stool must not be discarded in a washroom used by other patients.

33. Cohorting lab-confirmed cases with other lab-confirmed cases is an acceptable approach however placement should always be done under the direction of the ICP.

Outbreak Management Team

The outbreak management team *must* have the authority to institute changes in practice or take other actions that are required to control the outbreak based on evidence. All health care facilities should have an administrative protocol for dealing with infectious disease outbreaks, including the authority to relocate patients/residents, cohort patients/residents and staff, isolate patients/residents to their rooms, restrict admissions and transfers, restrict visitors, obtain appropriate laboratory diagnostics and administer relevant prophylaxis or treatment. Those with content/ clinical expertise *must* have the authority to direct processes.

34. Initiate a formal and inclusive outbreak management team which will meet frequently, if not daily to assess outbreak data and update team on status of interventions. The Outbreak Management Team (OMT) directs and oversees the management of all aspects of an outbreak.

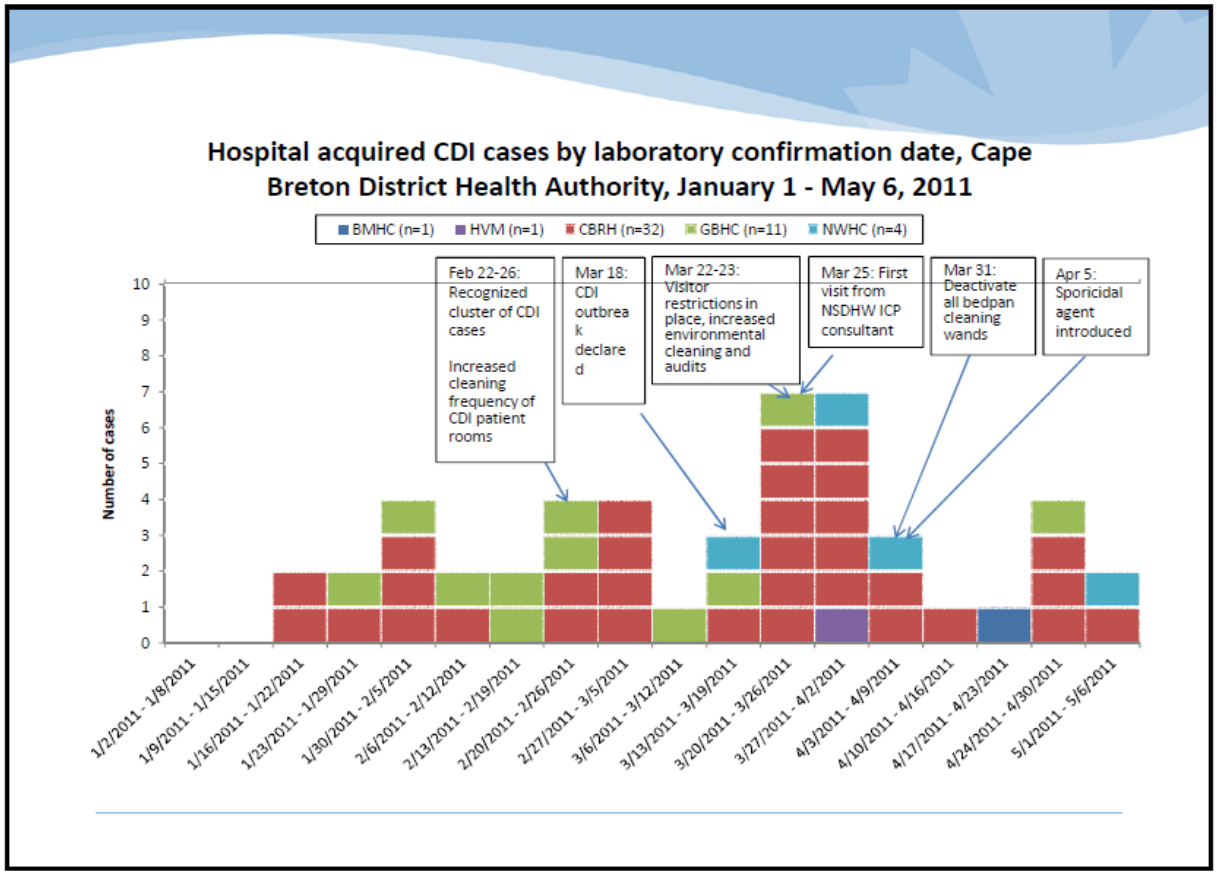
35. Ensure representation from the following: ICPs, Infectious Disease physician, if available, senior administration and appropriate hospital departments (i.e. environmental services, pharmacy, laboratory, purchasing, bed utilization/ discharge planner personnel, Occupational Health, public relations/ communications staff to handle media inquiries, etc.). It is important that representatives on OMT have decision-making power, particularly the ICP to direct practice changes of an infection prevention and control nature.

Antibiotic Stewardship & Medication Considerations

CDI is seen almost exclusively as a complication of antibiotic use. The development of a healthcare facility program to ensure appropriate antibiotic use is considered an important intervention for the control of CDI. The most common inappropriate antibiotic use that will place a patient at a high level and prolonged duration of risk is the continuation of broad-spectrum antibiotics after the etiology of infection has been identified and the pathogen is susceptible to a narrower spectrum antibiotic. The goal of an antimicrobial stewardship program is to optimize the use of the right drug, for the right purpose, and for the right duration in an effort to promote judicious use of the antimicrobial agent. To maintain a comprehensive approach to optimizing use of antimicrobial agents, it is important that the ICP understands the components of an antimicrobial stewardship program and the organizational support necessary for its success.

36. Through a multidisciplinary approach, including pharmacy, physicians, technological support, medical microbiology, infection prevention and control, and clinical resource nursing, implement an antibiotic stewardship program ensuring targeted antimicrobials meet the local epidemiology and strains present.

This graph demonstrates some of the interventions made during the course of the outbreak and their impact.



Infectious Disease Recommendations

37. In patients with CDI, consideration needs to be given to changing the implicated antibiotic(s) to antimicrobial agent(s) felt to pose a lower risk for CDI. Nonessential antibiotics must be discontinued. Other elements of management include the avoidance of prescribing antimotility agents and the prompt institution of supportive care (ie. hydration and electrolyte replacement).

    To identify the specific agent to use in the treatment of CDI, the patient should be evaluated to determine the severity of illness. The laboratory criteria that have been associated with more severe disease are a WBC count greater than 15,000 and / or a serum creatinine level greater than 1.5 the premorbid level, particularly in those over the age of 60 yrs. For mild to moderate disease, metronidazole is the recommended treatment. For those with severe disease, as determined by the clinical presentation and/or laboratory criteria, treatment with oral or nasogastric vancomycin is recommended. Those with more complicated disease (e.g. requiring ICU admission because of the

CDI, shock, ileus and toxic megacolon) should have consultation with a physician experienced in treating CDI, as well as potentially surgical consultation. For further information, the Infectious Diseases Society of America (IDSA) provides guidance on the management of CDI infection on their website. (http://www.jstor.org/stable/10.1086/651706)

Concluding Remarks and Moving Forward

This report presents the lessons learned from the outbreak of *Clostridium difficile* within CBDHA. Although the findings and recommendations are focused on what was occurring in that district, there is opportunity for other district health authorities to proactively take a detailed look at their own internal processes and make improvements are necessary.

While outbreaks tend to be viewed as failures in infection prevention and control practices to prevent transmission, there are numerous contributing factors that influence the outcomes. This particular outcome underscores the importance of investment in continuing education, training and competency assessment of infection control practitioners and environmental services staff as well as maintaining adequate staffing and resources that will contribute to the satisfactory fulfillment of a sustainable and effective infection prevention and control program.

This outbreak of *Clostridium difficile* caused serious illness, and tragically contributed to patient deaths. Although the district health authority should take pride in how the situation was managed both professionally and personally, it is important also to recognize there are important improvements to be made. The identified areas for improvement are not unique to CBDHA and have been identified in previous outbreaks both within Canada and elsewhere. These recommendations will help, not only CBDHA, but other district health authorities better prepare and respond to outbreaks if, and when they arise. The ultimate goal is to increase awareness and improve the overall effectiveness of Infection Prevention and Control programs to lessen the likelihood and impact of future outbreaks.

Finally it is important to recognize that Infection Prevention and Control is the responsibility of everyone involved in health care to provide safe medical care for our patients.

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