AJIC perspective on antimicrobial resistance

Infection control and antimicrobial restriction practices for antimicrobial-resistant organisms in Canadian tertiary care hospitals

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In 2003, a survey examining infection control and antimicrobial restriction policies and practices for preventing the emergence and transmission of methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant Enterococci (VRE), and extended spectrum β-lactamase (ESBL) was performed within Canadian teaching hospitals as part of the Canadian Nosocomial Infection Surveillance Program. Twenty-eight of 29 questionnaires were returned. The majority of facilities conducted admission screening for MRSA (96.4%) and VRE (89.3%) but only 1 site screened for ESBL/AmpC. Rates of MRSA, VRE, and ESBL remain low in Canada. It is believed that these lower rates may be due to intense admission screening protocols and stringent infection control policies for antimicrobial-resistant organisms (AROs) within Canadian institutions. Few (MRSA: 14.8%; VRE: 12.0%) recorded the number of patients screened. Regular prevalence surveys were done for MRSA (21.4%), VRE (35.7%), and ESBL/AmpC (3.8%). Pre-emptive precautions were applied for MRSA by 60.7% and for VRE by 75.0% of facilities. All facilities flagged patients previously identified with MRSA and VRE but only 46.2% flagged ESBL and 15.4% flagged AmpC patients. Barrier precautions varied by ARO and patient-care setting. In the inpatient non-ICU setting, more than 90% wore gowns and gloves for MRSA and VRE but only 50% for ESBL; and 57.1% wore masks for MRSA. Attempts to decolonize MRSA patients had been made by 82.1%, largely in order to place them in another facility. Policies restricting antimicrobial prescribing were reported by 21 facilities (75.0%). Further studies examining hospital infection control policies and corresponding rates of ARO infections would help in identifying and refining best practice guidelines within Canadian institutions. (Am J Infect Control 2007;35:563-8.)

Despite national guidelines, regional variation in infection control policies and protocols is known to occur among Canadian institutions. Canadian guidelines are not specific for handling antimicrobial-resistant organisms (AROs). The guideline for Routine Practices and Additional Precautions for Preventing Transmission of Infection in Health Care describes the recommended use of routine practices and contact precautions for infections and colonizations.[1] In 1997, the Society for Healthcare Epidemiology of America (SHEA)[2] published guidelines for the preventing of antimicrobial resistance in hospitals; in 2003, they published a special report with guidelines specific to preventing nosocomial transmission of multidrug-resistant strains *of Staphylococcus aureus* and *Enterococcus*.[3] The Canadian Nosocomial Infection Surveillance Program (CNISP) has collected surveillance data from a large medical teaching hospital for methicillin-resistant *Staphylococcus aureus* (MRSA) since 1995 and vancomycin-resistant Enterococci (VRE) since 1998. The admitted patient prevalence rates of MRSA have increased 13 fold since 1995 from 0.44 per 1000-patient admission to 5.86 in 2004.[4] In contrast, VRE rates were low at 0.3 per 1000-patient admission in 1999 with an increase to 0.6 in 2004.[4] Rates of extended spectrum β-lactamase (ESBL) and AmpC within Canadian institutions are largely unknown. In 2000, a survey of hospitals participating in CNISP found rates of 0.37/100 *Escherichia coli* isolates and 0.73/1000 *Klebsiella spp.* isolates, which were confirmed as ESBL producers.[5]

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CNISP is a collaborative effort of the Canadian Hospital Epidemiology Committee (CHEC), a subcommittee of the Association of Medical Microbiology and Infectious Disease Canada and the Centre for Infectious Diseases Prevention and Control of the Public Health Agency of Canada. CHEC hospitals are made up of the major acute tertiary care facilities in every province in Canada except for Prince Edward Island. CNISP conducted a survey to look at ARO screening and control practices at participating hospitals. The objectives of the survey were to describe the admission screening, infection control, and antimicrobial restriction practices for MRSA, VRE, and ESBL/AmpC (*E.coli* and *Klebsiella sp.* only) within CNISP hospitals and to determine if significant differences exist between sites.

METHODS

A survey was developed that included information on the infection control practices and polices and antimicrobial-use policies. Questions focused on admission screening protocol, contact-screening protocols, prevalence surveys practices, precautions used and their discontinuation, restrictive use of antimicrobials practices, and decolonization protocol. All 29 CNISP sites were asked to participate. A separate survey was developed for MRSA, VRE, and ESBL/AmpC–specific policies and procedures. The survey was completed by the infection control professionals in collaboration with the CHEC member who was assigned to hospital infection control for that CNISP hospital. One CNISP site may consist of one institution or one health region that used the same policies among several geographically close institutions. Information was collected for the year 2003 and sent to CNISP for analysis. Data were analyzed in the SPSS version 11.0 (SPSS Inc.).

RESULTS

Twenty-eight (96%) of 29 surveyed CHEC sites completed the questionnaires. Two of the multisite health care centers had slightly different policies for their separate hospitals; thus more than one questionnaire was returned from these two centers. Twenty-eight questionnaires were completed for MRSA and VRE practices, and 26 were completed for ESBLs.

Admission screening

The majority of hospitals conducted admission screening for MRSA (27/28 or 96.4%) and VRE (25/28 or 89.3%) (Table 1). For hospitals performing MRSA and VRE screening, all screened patients with a previous admission to an acute care facility were perceived as being at high risk for nosocomial transmission of MRSA and VRE. The criterion for screening was determined by the infection control department and was based on epidemiological data that identified high-prevalence areas. The criteria used varied significantly from center to center. However, the majority of sites' screened population included those with a previous admission to a hospital in the United States. Of those with prior United States hospital admissions within the past year, 25 of 28 (89.3%) sites performed admission screening for MRSA and 22 of 28 (82.1%) for VRE. Specifics for admission screening are listed in Table 1.

Table 1. Admission screening for MRSA and VRE in CHEC hospitals

	MRSA n (%)	VRE n (%)
Have admission screening policy	27 (96.4)	25 (89.3)
Screen patients admitted to specific units	10 (37.0)	9 (36.0)
Adult ICU	6 (22.2)	5 (20.0)
Dialysis unit	5 (18.5)	4 (16.0)
Transplant unit	1 (3.7)	3 (12.0)
Medicine	2 (7.4)	2 (8.0)
Hematology/Oncology	2 (7.4)	2 (8.0)
Screen patients with a previous admission	27 (100.0)	25 (100.0)
Outside of Canada	20 (74.1)	20 (80.0)
Outside of province	18 (66.7)	14 (56.0)
To your facility	17 (63.0)	8 (32.0)

Of those with admission screening policies, 10 (35.7%) screened all patients admitted to specific units for MRSA and 9 sites (32.1%) screened for VRE. Of the 26 sites surveyed, 1 (4%) site reported admission screening for ESBL and AmpC, but this was limited to the screening of patients admitted to the transplant unit.

Information on the time period for screening patients with a previous hospital admission was obtained as part of the survey. Sixteen of 28 sites (57.1%) indicated that patients were screened for MRSA if their previous hospital admission occurred was within the previous 6 months; 8 sites (28.6%) screened for MRSA if the previous admission occurred within the past year. Fourteen (50.0%) of 28 sites screened patients for VRE if the patient was previously admitted within the last 6 months, while 8 sites (28.6%) screened those admitted to hospital in the past year.

Twenty-seven of 28 sites (96.4%) indicated that potential contacts of patients with known MRSA and VRE were routinely screened. Eleven of 26 sites (42.3%) conducted screening on patients with potential contact with an ESBL carrier, and three facilities (11.5%) screened potential contacts of an AmpC carrier. Contacts routinely screened for resistant organisms are presented in Table 2.

Sites that did admission screening were asked if a written record was kept of the number of patients screened. Four of 28 sites (14.3%) reported having a written record of the total number of patients screened for MRSA. The remaining 24 (85.7%) sites only recorded the number of patients found to be positive on screening. For VRE, 3 of 28 sites (10.7%) reported having a record of the number of patients screened, while 21 (75.0%) kept a record of the number of patients screening positive.

Prevalence surveys

Six of 28 sites (21.4%) conducted regular prevalence surveys for MRSA. The specific patient population surveyed and specimen tested varied by site. Of the 6 sites who did routine prevalence surveys, most were done on adult critical care (66.7%) and/or on hemodialysis (50.0%) units.

Ten of 28 sites (35.7%) conducted routine VRE prevalence surveys, and of these, 6 (60.0%) also screened submitted stools for *C.difficile* testing. Five of the 10 sites (50.0%) conducted surveys in hemodialysis units. The frequency of prevalence surveys varied with 3 sites reporting weekly, to ongoing surveys in 3 sites and 1 site reporting annual surveys.

One (3.8%) of 26 CNISP sites that completed information on ESBL/AmpC reported conducting annual prevalence surveys for ESBL- and AmpC-producing organisms.

Precautions

All 28 CNISP hospitals had policies for ''flagging'' the chart if a patient was identified as MRSA- or VRE-positive. Twelve of 26 sites (46.1%) reported placing flags on the chart for patients identified as an ESBL carrier, and 4 of 26 sites (15.4%) reported flagging charts of patients positive for AmpC organisms.

CHEC sites were asked to identify the infection control precautions used for patients while they were being screened. This included use of gloves, gowns, masks, single rooms, and dedicated patient equipment. Seventeen of 28 sites (60.7%) indicated that precautions were applied to these patients prior to the availability of screening results. Three of these 17 sites (17.6%) reported that precautions were applied for all patients screened for MRSA. The remainder limited the use of precautions to patients transferred from hospitals known to have MRSA (n = 8; 47.1%), from hospitals outside of Canada (n = 12; 70.6%), or from other hospitals within Canada (n = 7; 41.2%). Other sites used precautions based on patient risk factors, such as isolation of burn and plastic surgery patients, history of having been positive for MRSA (n = 2 sites; 11.8%), or for direct admissions to the ICU from a hospital outside of Canada (n = 3; 17.6%).

Table 2. ARO screening policies for potential contacts of infected/colonized patients

	MRSA n (%)	VRE n (%)	ESBL n (%)	Amp-C N (%)
N facilities screening contacts	27 (96.4)	27 (96.4)	11 (42.3)	3 (11.5)
Population screened				
Roommates	24 (88.9)	23 (85.2)	10 (90.9)	0 (0.0)
Adjacent chairs	11 (40.7)	11 (40.7)	-	-
Adjacent rooms	10 (37.0)	10 (37.0)	2 (18.2)	0 (0.0)
Same ward	11 (40.7)	12 (44.4)	1 (9.1)	1 (33.3)
Other	3 (11.1)	4 (14.8)	1 (9.1)	0 (0.0)

Similarly, 21 of 28 sites (75.0%) reported using precautions while a patient is being screened for VRE. Of these 21 sites, 6 (28.6%) used precautions for all VRE patients being screened for VRE, while policies in other hospitals restricted use of precautions to patients transferred directly from hospitals known to have VRE (n = 8; 38.1%) from health care facilities outside Canada (n = 11; 52.3%), from another hospital or health region in Canada (n = 7; 33.3%), or to patients with a high risk of testing positive (e.g., contact of VRE case, n = 3; 14.3%).

There were no hospitals that initiated precautions for patients screened but not yet identified as ESBL- or AmpC-positive.

Precautions initiated for patients with positive test results for VRE, MRSA, ESBL, or AmpC are presented in Table 3. One of 26 sites reported that precautions were not used for any ESBL-positive inpatients, and 5 sites (19.2%) did not use precautions for inpatients testing positive for AmpC producing organisms.

CHEC sites that recommended the use of contact precautions were asked about their policy for discontinuing precautions. Twenty of 28 sites (71.4%) reported that three consecutive negative cultures were required to discontinue MRSA precautions for inpatients. The required interval between consecutive negative cultures ranged from 1 day to 1 week. Five sites (17.9%) never discontinued precautions in their ICUs, and four facilities (14.3%) never discontinued precautions for any inpatients.

For VRE, 16 of 28 sites (57.1%) reported that they required three consecutive negative cultures to discontinue VRE precautions for inpatients. The required interval for consecutive negative cultures ranged from 1 day up to 1 week. Six of the 28 sites (21.4%) indicated that they never discontinued precautions for patients in the ICU and 4 (14.3%) never discontinued precautions among non-ICU inpatients.

For ESBL- and AmpC-positive patients, 6 of 26 sites (23.1%) required three consecutive negative cultures

Table 3. Approaches to management of ARO-positive patients

	MRSA		VRE		ESBL		Amp-C	
Precaution	**ICU n (%)**	**Non-ICU n (%)**	**ICU n (%)**	**Non-ICU n (%)**	**ICU N (%)**	**Non-ICU n (%)**	**ICU N (%)**	**Non-ICU n (%)**
Single room	27 (96.4)	26 (92.9)	27 (96.4)	26 (92.9)	14 (53.8)	14 (53.8)	10 (38.5)	8 (30.8)
Patient cohorting	12 (42.9)	16 (57.1)	11 (39.3)	11 (39.3)	6 (23.1)	9 (34.6)	4 (15.4)	3 (11.5)
Gloves	27 (96.4)	28 (100.0)	28 (100.0)	26 (92.9)	14 (53.8)	14 (53.8)	11 (42.3)	9 (34.6)
Gowns	27 (96.4)	28 (100.0)	28 (100.0)	26 (92.9)	13 (50.0)	13 (50.0)	11 (42.3)	9 (34.6)
Masks	15 (53.6)	16 (57.1)	2 (7.1)	1 (3.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Dedicated patient equipment	25 (89.3)	26 (92.9)	25 (89.3)	23 (82.1)	14 (53.8)	13 (50.0)	11 (42.3)	9 (34.6)
Special room clean after patient discharge	17 (60.7)	18 (64.3)	21 (75.0)	19 (67.9)	9 (34.6)	7 (26.9)	6 (23.1)	5 (19.2)

to discontinue precautions for ICU patients. Two hospital sites (7.7%) stated never discontinue precautions in the ICU, and 1 site never discontinued precautions among any inpatient positive for an ARO.

MRSA decolonization

Twenty-three of 28 (82.1%) sites reported that they attempted to decolonize patients with MRSA. Primary reasons for these attempts included facilitating patient discharge to a long-term care facility (12 sites; 52.2%), a rehabilitation facility (12 sites; 52.2%), another acute care facility (8 sites; 34.8%), or as a mechanism to control an ongoing MRSA outbreak that was unresponsive to other control measures (9 sites; 39.1%).

Antimicrobial restriction

Twenty-one of 28 sites (75.0%) reported having policies restricting antimicrobial prescribing. While restrictions varied by site, 13 of 21 sites (61.9%) restricted prescribing of oral vancomycin, and 8 of 21 sites (38.1%) restricted use of intravenous vancomycin. Thirteen of 21 sites (61.9%) had policies restricting the use of linezolid and quinupristin/dalfopristin to infectious disease physicians. Fluoroquinolones were restricted to use for specific indications in 6 sites (28.6%) and to infectious disease physicians in 8 sites (28.6%). Sixteen sites (76.2%) restricted the use of third-generation cephalosporins for specific indications, specific units, or to infectious disease physicians. Only 3 sites (14.3%) restricted the use of intravenous clindamycin, and 2 sites (9.5%) restricted the use of oral clindamycin.

DISCUSSION

The use of contact precautions for the control of AROs has been recommended for years in Canada and the United States.[1,2,3] SHEA proposes an aggressive approach to precautions: active surveillance to combat MRSA, VRE, and the use of contact precautions for colonized or infected patients.[2,3] Active surveillance cultures are essential to identify reservoirs that facilitate the spread of MRSA and VRE infections and to make prevention and control of outbreaks possible. Concerns with this approach have focused on the effectiveness of screening patients on admission, whether screening is sufficient to detect colonized individuals and whether screening is sustainable in light of the changing epidemiology of MRSA and the increased prevalence of community-acquired MRSA.

In an unpublished study conducted in a Toronto hospital, 50% of MRSA cases identified in 2004 were detected through admission screening of high-risk patients.[6] Papia et al[7] reported that 36% of MRSA cases were identified through admission screening of patients directly transferred from another hospital or nursing home, or who had been hospitalized in the previous 3 months. MRSA-colonized patients were greater than 6 times more likely to have been transferred from a nursing home or greater than 13 times more likely to have had a previous history of MRSA colonization.[7] Laboratory and nursing costs were $8.34 CDN per specimen, for a total cost of $30,632 CDN for 1 year of screening. The average cost of implementing recommended infection control measures for patients colonized with MRSA was approximately $5235 per patient.[7] As admission screening facilitates the early detection of patients colonized or infected with AROs, this measure and the resulting implementation of appropriate infection control precautions are a key strategy for decreasing the nosocomial spread of AROs, thereby decreasing the costs if other patients acquired infections due to these cases.

In CNISP, the majority of participating CHEC sites reported conducting admission screening for MRSA and VRE. It is well known that patients who have previously been admitted to hospitals in the past year are at higher risk of carrying AROs.[8] This survey showed that the majority of major acute tertiary care facilities in Canada had policies to conduct admission screening

on all patients with a history of an inpatient hospital admission in the 6 months.

Hospital or health region specific policies for admission screening and managing patients for MRSA and VRE varied somewhat from site to site in the specific details used to implement the policy. A greater degree of variation was found among CHEC sites in the screening and management of patients positive for ESBL- and AmpC-producing organisms. This variation in policies is likely the result of multiple factors, including the low incidence of ESBL cases in Canada with very few associated outbreaks and the paucity of evidence-based literature on the most effective management strategies for ESBLs.[9] Best practices for the infection control for screening and management of ESBLs are similar to those recommended for MRSA and VRE.[10] Screening for ESBL is likely to be useful amongst certain high-risk populations once ESBLs are endemic in a facility or a geographic area.

The survey found that the majority of facilities (82.1%) had attempted to decolonize patients with MRSA for various reasons. Decolonization has not been routinely recommended for the management of MRSA, because decolonization requires the use of an antibiotic treatment to eliminate MRSA carriage and it has resulted in emergence of antibiotic resistance in some cases.[11] However, decolonization has been successfully used to control outbreaks or in situations in which the risk of transmission is high.[11]

To date there have been little data available regarding antibiotic utilization in Canadian hospitals. This survey found that 75% of CHEC sites had antimicrobial restriction policies in place; however, the impact of this strategy alone cannot be measured. Although there are studies that have shown the benefits of antimicrobial stewardship, a comprehensive strategy that includes both judicious antimicrobial use and mechanisms to prevent and control transmission of ARO must be used to slow the emergence of AROs in hospitals.

One of the limitations of the survey was the inability to assess compliance to existing hospital policies such as admission screening. Williams et al[6] reported that compliance with MRSA admission screening policies was 81%, indicating that some positive patients may go unrecognized during their hospital stay, resulting in further nosocomial transmission. Finally, as CNISP sites are those with dedicated hospital epidemiologists and infection control professionals with demonstrated interest and expertise in infection control, it makes the generalizing of the results from this survey to other Canadian hospitals be considered difficult.

Antibiotic resistance is a problem that requires significant response to limit the transmission of ARO. Canadian rates for MRSA and VRE are lower than those in many other countries.[4] However, our experience and that of other countries[12] has shown that patient-to-patient transmission of AROs still occurs within health care facilities despite the use of admission screening and precautions. A comprehensive approach to the prevention and control of AROs is needed similar to the aggressive approach used in the Netherlands.[12] Initiatives and strategies must incorporate infection control practices and surveillance to prevent and monitor transmission of organisms as well as practice guidelines and educational interventions to decrease antibiotic pressure.

Rates of MRSA, VRE, and ESBL remain low in Canada. It is believed that these lower rates may be influenced by intense admission screening protocols and stringent infection control policies for AROs within Canadian institutions.

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