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infection control guidelines

Preventing the Spread of Vancomycin-Resistant Enterococci (VRE) in Canada

Foot Care by Health Care Providers

Preventing Infections Associated with Indwelling Intravascular Access Devices

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1

Preventing the Spread of Vancomycin-Resistant Enterococci (VRE) in Canada

2

Foot Care by Health Care Providers

3

Preventing Infections Associated with Indwelling Intravascular Access Devices

Table of Contents

Foot Care by Health Care Providers

Preventing Infections Associated with Indwelling Intravascular Access Devices

Introductory Statement

The primary objective in developing clinical guidelines at the national level is to assist health care professionals in improving the quality of resident care. Guidelines for the control of infection are needed to assist in developing policies, procedures and evaluative mechanisms to ensure an optimal level of care. Guidelines facilitate the setting of standards but respect the autonomy of each institution and recognize the governing body's authority and responsibility of ensuring the quality of resident care provided by the institution.

The guidelines, whenever possible, have been based on research findings. There are some aspects about which there is insufficient published research, and, therefore, consensus of experts in the field has been utilized to provide guidelines specific to conventional practice.

Both encouragement of research and frequent revision and updating to keep pace with advances in the field are necessary if guidelines are to achieve the purpose for which they have been developed.

The Steering Committee acknowledges, with sincere appreciation, the many practising health professionals and others who contributed advice and information to this endeavour.

The guidelines outlined herein are part of a series that have been developed over a period of years under the guidance of the Steering Committee on Infection Control Guidelines Development. *Infection Control Guidelines for Preventing the Spread of Vancomycin-Resistant Enterococci in Canada* presents an overview of VRE and recommendations to assist in the prevention of the transmission of VRE in health care facilities; *Foot Care by Health Care Providers* contains information on routine foot care that is not intentionally invasive; and in *Preventing Infections Associated with Indwelling Intravascular Access Devices* the principles are set out for preventing infection from the use of peripheral and central, venous and arterial access devices in hospital, outpatient and home care settings. This document is part of the Health Canada series of *Infection Control Guidelines* and is intended to be used with the other *Infection Control Guidelines.* Others in the series include the following:

- *Preventing the Transmission of Bloodborne Pathogens in Health Care and Public Services Settings* (1997)
- *Isolation and Precaution Techniques* (1990) (under revision)
- *Cleaning, Disinfection, Sterilization and Antisepsis in Health Care* (revision of *Part V - Hospital Environmental Control* [1990] will be published as a CCDR supplement in 1998)
- *Preventing the Transmission of Tuberculosis in Canadian Health Care Facilities and Other Institutional Settings* (1996)
- *Canadian Contingency Plan for Viral Hemorrhagic Fevers and Other Related Diseases* (1997)
- *Occupational Health in Health Care Facilities* (1990) (under revision)

- *Prevention of Nosocomial Pneumonia* (1990) (under revision)
- *Long Term Care Facilities* (1994)
- *Antimicrobial Utilization in Health Care Facilities* (1990)
- *Prevention of Surgical Wound Infections* (1990)
- *Prevention of Urinary Tract Infections* (1990)
- *Perinatal Care* (1988)
- *Organization of Infection Control Programs in Health Care Facilities* (1990)

For information regarding the above Health Canada publications, contact:

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PREVENTING THE SPREAD OF VANCOMYCIN-RESISTANT ENTEROCOCCI (VRE) IN CANADA

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Overview of VRE

Our understanding of the epidemiology and natural history of colonization and infection with vancomycin-resistant enterococci (VRE) is evolving and will continue to evolve. Several studies suggest that VRE colonization is much more common than infection and that colonization may persist for months to years. Clearly, this has important implications for health care settings, where focusing of efforts on known colonized patients may miss the potentially larger number of unknown colonized patients who may serve as sources of transmission. A prolonged state of colonization also presents logistical problems with respect to the precautionary management of these patients as they move across the continuum of care (acute care, chronic care, and home care) and as their illness changes from symptomatic to asymptomatic. Special isolation/ precautionary techniques have had variable success in controlling the spread of VRE. While some studies have shown their usefulness in outbreak situations, others have not shown an impact. Thus, much remains to be learned about the effect of VRE in colonized patients, the factors that predict the risk of nosocomial spread, and identification of measures that will prevent that spread. The use of maximal precautions/techniques to prevent transmission in all settings is both impractical and expensive. The level of precautions used for a colonized/infected patient with VRE must take into consideration a risk assessment of the patient with respect to the likelihood of transmission (level of hygiene, continence, degree of illness, presence of co-morbid conditions) and the health care setting in which the patient is placed. An appropriate balance must be achieved to prevent nosocomial transmission and to avoid ostracizing the patient and gridlocking the health care system.

It is important to recognize that the risk factors for infection with VRE are related in part to the underlying illness of the individual. Although VRE bloodstream infections have been associated with high rates of mortality, the risk of death is most strongly related to the severity of the underlying illness rather than the VRE infection. The pathogenicity of vancomycin resistance in enterococci as a cause of mortality in patients with enterococcal bloodstream infections needs to be further assessed.

The recommendations in this document are rated according to the strength of the evidence supporting them and the quality of the supportive studies (see Appendix p. 1-16). The recommendations acknowledge the different situations that health care facilities must address and the different levels of precautions that may be required in varying circumstances. Although the emphasis of the recommen- dations is on meeting the needs of acute care facilities, long-term care facilities may also refer to them for assistance or to the *Infection Control Guidelines for Long-Term Care Facilities*[1]. Additional assistance can be obtained by contacting the local public health personnel, who are available for consultation and may play an important role in developing an integrated approach to the control of antibiotic-resistant organisms (including VRE) in the community. Practitioners will have to apply these guidelines to suit their institutional needs. It is not possible to prevent all transmissions, and the benefit obtained from measures taken to reduce the risk of transmission must be balanced against the cost and feasibility of routine application of these measures. The guidelines in this document are based on current information and, as for other guidelines, may be modified as new information becomes available. VRE and other antibiotic-resistant organisms will be addressed in the revision of the *Isolation and Precaution Techniques* guidelines. The following discussion has been provided to organize and facilitate an understanding of VRE. The components to be discussed are:

i) Epidemiology of VRE

ii) Microbiology of Enterococci

iii) Antibiotic Resistance in Enterococci

iv) Antimicrobial Susceptibility Testing of Enterococci

v) Risk Factors for VRE

Epidemiology of VRE

Enterococcus species are now recognized as important nosocomial pathogens. They have emerged as the second or third most common cause of nosocomial infections[2,3] in recent reports from the National Nosocomial Infections Surveillance (NNIS) system at the U.S. Centers for Disease Control and Prevention (CDC). Between 1989 and 1993 there was a 23-fold rise in VRE infection, from 0.3% to 7.9% of nosocomial enterococcal infections reported to the NNIS system[4]. The increase was due mainly to a rise from 0.4% to 13.6% of VRE infection in intensive care units. The presence of VRE in the hospitals reporting to the NNIS system was associated with a size of 200 beds or more and a university affiliation[4]. Since the automated procedures used in many clinical laboratories do not efficiently detect vancomycin resistance, concerns have been raised that moderate vancomycin resistance has been unrecognized in many U.S. health care facilities. The prevalence of VRE has increased in Europe over the past 10 years since being identified in 1986[5,6].

The epidemiology of VRE in Canada has not been fully elucidated. The first isolates, from two patients, were reported in 1993[7]. Although sporadic reports of small numbers of colonized and/or infected patients have been made[8], the first outbreak of VRE in Canada occurred in the autumn of 1995[9] and involved 38 patients, the majority of whom were receiving dialysis. In 1996, a survey of the Canadian Hospital Epidemiology Committee (CHEC) members, representing 21 health care facilities across Canada, indicated that 12 (57%) had previously conducted surveillance for VRE and 4 institutions had identified VRE, in a total of 37 patients[10]. Since this survey, increasing numbers of Canadian acute care facilities have reported isolation of VRE in patients. The prevalence of VRE within Canadian health care facilities should be further defined with the completion of the National VRE Point Prevalence Project and the establishment of the National VRE Sentinel Hospital Surveillance Program.

Microbiology of Enterococci

For many years, enterococci were considered relatively harmless avirulent flora with little potential for human infection. They are found as normal commensal flora of the gastrointestinal tract in 95% of healthy individuals and as non-pathogenic colonizing flora in the vagina, oral cavity, perineal area, hepatobiliary tract, and upper respiratory tract[11-14]. Open wounds and decubitus ulcers may act as reservoirs for enterococci[12]. The most commonly encountered species include *Enterococcus faecalis* (*E. faecalis*) and *E. faecium*; those encountered less frequently are *E. avium*, *E. durans*, *E. gallinarum*, *E. casseliflavus* and others (Table 1). *E. faecalis* is found in large concentrations of 10^5-10^7 colony-forming units (CFU)/g of faeces in the vast majority of humans, and the remaining enterococci are found in smaller amounts[11]. Enterococci are hardy organisms and are able to survive on environmental surfaces for extended periods. Several studies have found multi-resistant strains of enterococci on various objects in the patient's environment, including bed rails, night tables, curtains, bathroom sinks, toilet rings, electronic thermometers, and other patient-care equipment[15-19].

Table 1

Distribution of *Enterococcus* Species in Clinical Isolates and Stool

Body Sites	# of Clinical Samples	*E. faecalis*	*E. faecium*	*E. casseliflavus*	*E. gallinarum*	*E. avium*	*E. raffinosus*
Urine	284	93.7%	5.3%	0.7%	0	0	0.3%
Blood and catheter	26	53.8%	42.3%	3.8%	0	0	0
Deep abscess	110	72.7%	22.7%	0.9%	1.8%	0.9%	0
Wounds and mucous membranes	132	90.9%	6.8%	0	0.8%	0	0
Resp. tract (ICU)	22	50.0%	45.5%	0	0	0	4.5%
TOTAL	**574**	**85.5%**	**12.1%**	**0.7%**	**0.5%**	**0.2%**	**0.4%**
Stool							
Hospitalized patients	115	36.0%	39.3%	9.3%	11.3%	15.3%	0.6%
Healthy individuals	95	47.0%	55.0%	13.0%	4.0%	8.0%	1.0%
TOTAL	**210**	**40.5%**	**45.6%**	**10.5%**	**8.4%**	**12.4%**	**0.8%**

Adapted from Blaimont B, Charlier J, Wauters G. *Comparative distribution of **Enterococcus** species in faeces and clinical samples.* Microbial Ecology in Health and Disease 1995;8:87-92.

Antibiotic Resistance in Enterococci

Enterococcal species are intrinsically resistant to many antibiotics and have demonstrated a remarkable capacity to acquire resistance[20-22]. Enterococci have constitutive resistance to cephalosporins, penicillinase-resistant penicillins, clindamycin, low-level aminoglycosides, and probably trimethoprim-sulfamethoxazole[23-25]. For serious enterococcal infections, the combination of a cell-wall active agent (a ß-lactam or glycopeptide) and an aminoglycoside is necessary to achieve bactericidal activity[26-29].

Over the past 2 decades there have been an increasing number of reports of *Enterococcus* species with induced resistance to multiple antibiotics, and therapeutic options have become increasingly limited. The first evidence of high-level resistance of *Enterococcus* species to streptomycin and gentamicin (minimum inhibitory concentration [MIC] > 2,000 µg/L) was documented in the 1970s[30,31], and during the 1980s the prevalence of these resistant strains increased dramatically in several locales in North America and Europe[2,32]. High-level aminoglycoside resistance eliminates the option of using aminoglycosides in combination with cell-wall active agents (e.g., penicillin or ampicillin) for synergistic activity[33]. Resistance to ampicillin[34-36] is being seen with increasing frequency and may be due to a decreased ability to bind to penicillins or to the production of ß-lactamase by the microorganism.

The development of resistance to vancomycin, which is potentially much more problematic, was first reported in Europe in 1986[37]. Since then, outbreaks of VRE infections have been described in several institutions and other health settings[38-43] in the United States. The mechanisms of resistance to vancomycin have been described[44], but the concern from a clinical perspective is the loss of vancomycin and other glycopeptide antibiotics for the treatment of serious enterococcal infections. With an increasing incidence of *Enterococcus* species resistant to both penicillins and aminoglycosides, the addition of vancomycin resistance would severely limit therapeutic options. The vancomycin-resistance trait in *Enterococcus* species is transferable, and perhaps the greatest threat of VRE is the potential emergence of vancomycin resistance in methicillin-resistant *Staphylococcus aureus* (*S. aureus*) or *S. epidermidis*, which would create a major concern[45,46].

There is some variability in the phenotypic and genotypic characteristics of VRE (see Table 2). The strains can be classified phenotypically according to the level of their resistance (low or high) to vancomycin and teicoplanin[47]. Four phenotypes of glycopeptide resistance have been recognized. The phenotype usually corresponds to the genotype of the same name, as determined by detection of the gene responsible for the resistance pattern. Van A phenotype constitutes a high-level resistance to vancomycin and teicoplanin[37]. Van B phenotype represents a low- to high-level resistance to vancomycin only[48]. Van C phenotype is associated with low-level resistance to vancomycin[49]. For the purpose of this document, only Van A and Van B phenotypes are considered. Vancomycin resistance, in the case of *E. faecium* and *E. faecalis*, is either of Van A or Van B phenotype and is acquired, inducible and capable of transfer to other gram-positive cocci. Vancomycin resistance in *E. gallinarum* and *E. casseliflavus* is intrinsic, and transferability of the vancomycin-resistance genes has never been observed.

Table 2 Characteristics of Glycopeptide-Resistant *Enterococcus* Species

Resistance Type and Phenotype	Genotype	MIC (µg/mL) Vancomycin	MIC (µg/mL) Teicoplanin	Expression	Transferability by Conjugation	Species
Acquired						
Van A	Van A	64-1000	16-512	Inducible	Positive	*E. faecium* *E. faecalis* *E. avium*
Van B	Van B	4-1000	0.5-1	Inducible	Positive	*E. faecium* *E. faecalis*
Intrinsic						
Van C	Van C	2-32	0.5-1	Constitutive	Negative	*E. gallinarum*
Other than Van A, B, C	Van C	2-32	0.5-1	Constitutive	Negative	*E. casseliflavus*

Antimicrobial Susceptibility Testing of Enterococci

Antimicrobial susceptibility testing can be performed using different methods. The traditional methods have been broth or agar dilution and disk diffusion. More recently, automated systems have gained wide usage for antimicrobial susceptibility testing. Accurate test results are crucial for both patient management and infection control measures. All the methods mentioned reliably detect strains exhibiting the higher levels of vancomycin resistance (MIC $\geq$ 128 µg/mL). However, disk and automated systems have varied in their abilities to detect low to moderate levels of resistance (8-64 µg/mL)[50-52]. The National Committee for Clinical Laboratory Standards (NCCLS) has made recommendations on the procedures and interpretive criteria used in disk diffusion testing for vancomycin and teicoplanin, which should be followed to ensure reliable detection of VRE[53]. Willey et al. found an agar screening plate with brain heart infusion (BHI) agar incorporating 6 µg/mL of vancomycin to be useful in the detection of VRE with both high- and low-level resistance[50]. Their findings were confirmed by Swensen et al.[54]. The E test has been shown to accurately predict susceptibility to vancomycin (98.7%) and teicoplanin (94.1%) as compared with broth microdilution and disk diffusion[55], although there are not yet enough published data to allow the test to be recommended as a standard method for antimicrobial susceptibility testing of *Enterococcus* species. It has thus been recommended that laboratories in areas where VRE is endemic should use strategies such as disk diffusion testing or vancomycin agar screening plates[50] to augment their automated systems. Agar or broth dilution testing systems to determine MICs are, as indicated, also reliable[56]. Details on the use of alternative agar testing are beyond the scope of this document. Depending upon VRE epidemiology and laboratory testing, it is recommended that laboratories ensure that a mechanism is available to determine vancomycin resistance and high level resistance to penicillin and aminoglycosides of isolates from all clinically important isolates.

Risk Factors for VRE

Studies to date suggest that certain patient populations are at increased risk of VRE infection and colonization. Patients (both adult and pediatric) from critical care units, hematology-oncology wards, dialysis units, or transplantation units, or patients who have had major intra-abdominal or thoracic procedures appear to be at higher risk than other populations[38,57-61]. Several studies have identified risk factors for VRE infection and/or colonization. These factors include previous antibiotic therapy, multiple antibiotic therapy, vancomycin therapy, indwelling foley catheters, central venous catheterization, renal insufficiency, increased duration of hospital stay, multiple hospital admissions, and the elderly population[15,16,18,38-40,42,43,62-67]. These studies have demonstrated the transmission of VRE by direct patient contact or by carriage on the hands of health care personnel, contaminated environmental surfaces and contaminated patient care equipment. Environmental contamination is attributed largely to heavy shedding as may be more often seen in patients with diarrhea or fecal incontinence, or uncontained draining wounds. Studies have documented the carriage of high-level aminoglycoside-resistant enterococci in medical personnel and residents of extended care facilities[68,69].

VRE Guidelines Overview

The growing threat of VRE in the United States prompted the development of specific recommendations to prevent the spread of VRE, which were published in early 1995[67]. The recommendations were developed by a subcommittee of the CDC's Hospital Infection Control Practices Advisory Committee (HICPAC). The recommendations focused on a plan that addressed the following issues:

1) Vancomycin use
2) Educational programs
3) Enhancing the detection and reporting of VRE
4) Infection control precautions to prevent nosocomial transmission of VRE.

It is considered prudent to adopt, in principle, the HICPAC recommendations for preventing the spread of VRE for the following reasons: the appearance of VRE in several Canadian institutions in 1995 and 1996; the rising usage of vancomycin and other broad spectrum antimicrobial agents; increased awareness of settings in which some or all of the risk factors for VRE infection and colonization are present; and the current restructuring in Canadian health care facilities. The Canadian Hospital Epidemiology Committee believes that, although the epidemiology of VRE has not been fully elucidated in Canada and that further research is required, it is prudent to take the opportunity to reduce the emergence and spread of VRE in Canada now rather than after VRE has become firmly established. The following guidelines, adapted from the HICPAC recommendations[67], should be regarded as interim guidelines for Canadian health care facilities and will be subject to modification in the future. The Steering Committee on Infection Control Guidelines will address VRE and other antibiotic-resistant organisms in the *Isolation and Precaution Techniques* document that is currently being revised.

Guidelines for Preventing the Spread of VRE (adapted from HICPAC)

A. Judicious Use of Vancomycin

Situations in which the use of vancomycin is appropriate or acceptable

a. For treatment of serious infections due to ß-lactam-resistant gram-positive microorganisms. Clinicians should be aware that vancomycin may be less rapidly bactericidal than ß-lactam agents for ß-lactam-susceptible *Staphylococcal* species.

b. For treatment of infections due to gram-positive microorganisms in patients with life-threatening allergy to ß-lactam antimicrobials.

c. When antibiotic-associated colitis (AAC) fails to respond to metronidazole therapy or if AAC is severe and potentially life-threatening.

d. Prophylaxis, as recommended by the American Heart Association, for endocarditis preceding/during certain procedures involving patients at high risk for endocarditis.

e. Prophylaxis for major surgical procedures involving implantation of prosthetic materials or devices, e.g., cardiac and vascular procedures and total hip replacement, at institutions with a high rate of infections due to methicillin-resistant *Staphylococcus aureus* (MRSA) or methicillin-resistant *S. epidermidis* (MRSE). There are very few institutions in Canada where MRSA is endemic[70].

Situations in which the use of vancomycin should be discouraged

a. Routine surgical prophylaxis other than in a patient with life-threatening allergy to ß-lactam antibiotics.

b. Empiric antimicrobial therapy for a febrile neutropenic patient when an infection is unconfirmed. However, if there is strong evidence at the outset that the patient has an infection due to gram-positive microorganisms (e.g., inflamed exit site of Hickman catheter) *and* MRSA is endemic in the hospital, vancomycin may be indicated.

c. Treatment in response to a single blood culture positive for coagulase-negative staphylococci (if other blood cultures drawn in the same time frame are negative, or if contamination of the blood culture is likely). Because contamination of blood cultures with skin flora, e.g., *S. epidermidis*, may lead to vancomycin being administered to patients inappropriately, phlebotomists and other personnel who obtain blood cultures should be trained properly to minimize microbial contamination of specimens.

d. Continued empiric use for presumed infections in patients whose cultures are negative for ß-lactam-resistant gram-positive microorganisms.

e. Systemic or local (e.g., antibiotic lock) prophylaxis for infection or colonization of indwelling central or peripheral intravascular catheters.

f. Selective decontamination of the digestive tract.

g. Eradication of MRSA colonization.

h. Primary treatment of antibiotic-associated colitis (AAC)[71].

i. Routine prophylaxis for very low-birth-weight infants.

j. Routine prophylaxis for patients on continuous ambulatory peritoneal dialysis or hemodialysis.

k. Treatment (chosen for dosing convenience) of infections due to ß-lactam-sensitive gram-positive microorganisms in patients with renal failure.

l. Use of vancomycin solution for topical application or irrigation or for pre-transplant gut decontamination.

B. Educational Program

Information about VRE and other antibiotic-resistant organisms and their potential impact

Information regarding the emergence of VRE as a significant nosocomial pathogen in Europe and the United States should be provided to all hospital staff. This may be done in the context of education about other antibiotic-resistant organisms. Special emphasis should be placed on

providing continuing education programs to the medical, nursing, pharmacy, and administrative staff. Information about the epidemiology of VRE, risk to patients, and VRE's impact on antimicrobial prescribing practices and on hospital and financial resources should be emphasized.

Information about the influence of antimicrobial usage on the emergence of VRE and other antibiotic-resistant organisms

Many health care facilities throughout the United States and Canada are facing the increasing emergence of antibiotic-resistant organisms (AROs). The emergence of VRE is but one example of many AROs that are a problem in our population. There are several reasons for the emergence of these AROs[72], but paramount has been the selective pressure of intense antimicrobial use, much of it excessive and inappropriate, over the past decade or two.

C. Enhancing the Detection and Reporting of VRE in the Microbiology Laboratory

The ability of the microbiology laboratory to accurately identify *Enterococcus* species and detect vancomycin resistance is an integral component in recognizing the emergence of VRE colonization and infection in health care facilities. Cooperation and communication between the laboratory and those responsible for infection control is equally important (see Figure 1 for information on response to a report of VRE).

Identification of *Enterococcus* species

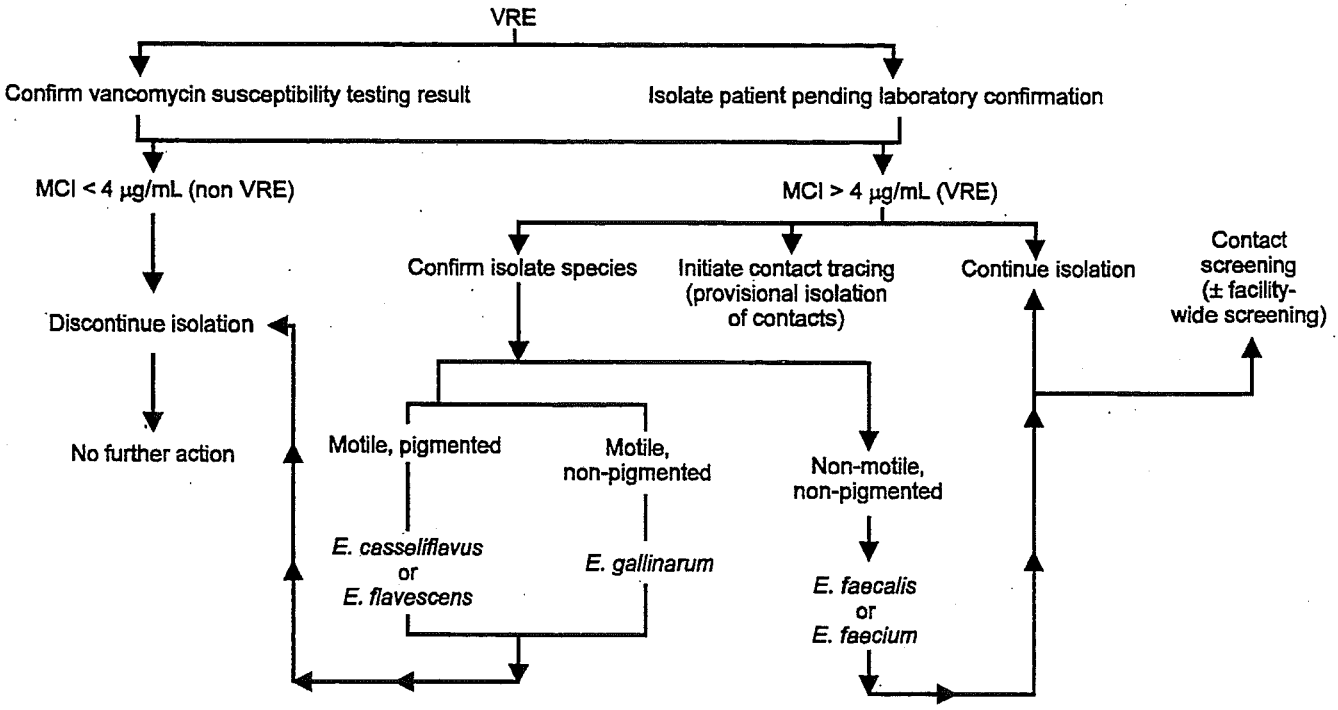
A system for presumptive identification of enterococci on primary isolation media is required in the microbiology laboratory. For laboratories not familiar with identifying VRE, additional tests for motility and pigment production may be required to distinguish *E. gallinarum* and *E. casseliflavus* from *E. faecium* and *E. faecalis*. For those laboratories not familiar with these methods or if financial resources do not permit such identification, a mechanism should be in place for the prompt referral of organisms to provide an appropriate level of identification with a rapid turnaround time.

Susceptibility testing

Routine testing

Depending on local surveillance and jurisdictional practices, laboratories should ensure that a mechanism is available to determine vancomycin resistance and high level resistance to penicillin and aminoglycosides of isolates from blood and all other clinically important isolates. If resources do not permit routine testing of isolates then periodic surveys of antimicrobial susceptibility to vancomycin should be done, the frequency determined by the local/provincial epidemiologic patterns of VRE.

Figure 1 Infection Control Response to Report of VRE



Reliable methods such as agar dilution or broth microdilution rather than automated or disk diffusion testing must be used[53,73,74].

Confirmatory testing

If VRE is isolated from clinical specimens, the guidelines presented below should be followed. It is important to emphasize that if VRE is found from *one* body site it can be assumed to be present in multiple body sites. Often, vancomycin resistance is detected before speciation is complete. It is important that species identification and vancomycin resistance are confirmed. Thus, confirmation of vancomycin resistance by repeat antimicrobial susceptibility testing using any of the recommended methods described previously, especially if VRE isolates are unusual in the facility, may be required. Alternatively, one may streak 1 µL of standard inoculum (0.5 McFarland) from an isolated colony of *Enterococcus* species onto BHI agar containing 6 µg/mL of vancomycin, incubate the inoculated plate for 24 hours at 35° C, and consider any growth indicative of vancomycin resistance[53,54]. The following values set by the NCCLS[53] can be used as a guide to confirm VRE:

Susceptible –	MIC ≤ 4 µg/mL
Intermediate –	MIC 8-16 µg/mL
Resistant –	MIC ≥ 32 µg/mL

Immediate infection control (IC) notification

During performance of confirmatory susceptibility tests, IC and appropriate patient care personnel should be notified regarding the presumptive identification of VRE. The infection control practitioner should assess whether isolation is required until species identification and vancomycin resistance are confirmed. This preliminary report should be followed by the (final) result of the confirmatory test.

Routine surveillance procedures for detecting VRE where VRE has not been previously detected

Antimicrobial susceptibility survey of clinical isolates

Laboratories should routinely screen for vancomycin resistance in all clinically significant enterococcal isolates obtained within the facility from any body site. Susceptibility tests performed only on enterococci recovered from sterile body sites would detect only a small number of clinical VRE isolates[43,75].

Culture survey of stools or rectal swabs

In tertiary medical centres and other hospitals with many critically ill patients at high risk of VRE infection or colonization (e.g., intensive care units, oncology units, transplant patients), periodic culture surveys of stools or rectal swabs of such patients can detect the appearance of VRE. Fecal screening is recommended even when VRE infections have not been identified clinically, because gut colonization may occur in patients in a facility before infections are identified[76,77]. The frequency and intensity of surveillance should be based on the size of the population at risk, the specific hospital unit(s) involved, the prevalence of VRE in the area, and the cost-benefit ratio of screening.

Screening procedures for detecting VRE when a first isolate of VRE has been detected

The finding of a first isolate of VRE should prompt fecal screening (stool survey or rectal swabs) for the identification of other colonized patients in an effort to establish the optimal and timely application of isolation precautions and control measures. It must be emphasized that the use of screening surveys are merely a tool to elucidate the epidemiology of VRE within a given ward, patient population or facility and are not considered a mandatory component of an infection control program. The optimal timing and extent of screening procedures remains unknown. Currently, there are no data available on cost-effectiveness. Consideration of patient populations, risk factors for acquisition of VRE, and the costs and resources available within the facility must be taken into consideration when implementing screening procedures. As a minimum, stools or perirectal swabs may be obtained from roommates and other close contacts of patients found to be newly colonized with VRE. Additional screening of patients on the same ward or unit may also be considered. In outbreak situations, it may be necessary to screen patients outside of the ward to avoid missing colonized patients. The utility of massive screening efforts directed at all possible contacts, entire health care facility patient populations and staff is unknown at this time and such efforts are not currently recommended.

D. Infection Control Precautions to Prevent the Transmission of VRE in the Health Care Setting

The infection control practitioner or other responsible individual must be aware that there are several different *Enterococcus* species. However, *E. faecalis* and *E. faecium* represent the species most often associated with disease and nosocomial transmission. Laboratories unfamiliar with speciation and susceptibility testing of enterococci may not correctly differentiate *E. faecalis* and *E. faecium* from other VRE that do not warrant the same infection control precautions. Practitioners must confirm that their laboratory uses methods that will reliably identify these other species of *Enterococcus* (e.g., *gallinarum, casseliflavus*) that are intrinsically resistant to low levels of vancomycin. *Enterococcus gallinarum* (*E. gallinarum*) and *E. casseliflavus* are less likely to be pathogens, their resistance has never been observed to transfer to other bacteria, and they do not require isolation, as do other VRE. If the laboratory identifies a VRE, the practitioner must confirm that it has been identified to species level, by a reference laboratory if necessary. VRE isolates should be confirmed as such by

laboratories experienced in enterococci identification and genotyping.

The presence of any isolate of VRE other than *E. gallinarum* and *E. casseliflavus* (VRE positive) from a single patient should receive prompt attention by infection control or other responsible personnel, and the ensuing guidelines should be initiated (Figure 1).

RECOMMENDATIONS

a. The use of a single room with a private bathroom is essential for VRE positive patients with diarrhea, fecal incontinence, an ileostomy or colostomy, or open wounds, or in whom basic personal hygienic practices may be compromised by illness or age. Infants, toddlers, and cognitively or functionally impaired elderly patients are unaware of good hygienic practices. The large amount of hands-on care they require increases the likelihood of infection being transmitted or acquired. Therefore, education of parents and family members about the role of good hand washing and prompt disposal of diapers and soiled garments in the prevention of VRE transmission is of utmost importance[78]. Patients without these symptoms or medical conditions and in whom basic hygienic practices are not compromised present less of a risk for transmission of VRE. There are no clear guidelines as to how such patients are best managed. Personal hygiene is a major factor that will guide decisions concerning isolation precautions. **(Category B; Grade III – see Appendix)**

b. Health care personnel should wear gloves and gowns when entering the room of a patient who has been placed in isolation[43,79,80]. It is important to change gloves between patient-care tasks. **(Category B; Grade III)**

c. Gloves and gowns should be removed before leaving the patient's room and hands washed carefully with an antiseptic agent[79,81-84] or an antiseptic hand rinse if sinks are not readily available. After hand washing, the hands should not contact potentially contaminated environmental surfaces in the patient's room. **(Category B; Grade III)**

d. For patients in isolation, equipment such as stethoscopes, blood pressure cuffs, scales, and all thermometers and thermometer components, including the electronic thermometer base, should remain in the room to be used with the patient colonized/infected with VRE[16]. These items should be cleaned and appropriately disinfected before being used with other patients[79,85]. Toys and infant weigh scales can serve as a reservoir of VRE in a nursery and/or pediatric unit. Only washable toys (no stuffed animals) should be available, and they should be disinfected before being put back into general circulation. A barrier (e.g., paper towel) should be placed between the infant and the weigh scale to ensure minimum contamination. Proper disinfection of the scale is essential after use. Any equipment used for multiple patients, such as portable radiographic machinery, electroencephalographic or pulse oximetry equipment, that comes in contact with the patient with VRE or potentially contaminated environmental surfaces should be cleaned with a low level disinfectant immediately after use[79]. **(Category B; Grade III)**

e. Screening surveys (perirectal swabs or stools, cultures of open wounds and drainages) should be conducted of roommates of patients newly found to be VRE positive. Additional screening of other ward patients, other potential contacts, staff and the environment may also be considered in outbreak situations, depending on the individual circumstances at the health care facility. **(Category B; Grade III)**

f. There should be a policy for discontinuation of isolation. The optimal requirements are unknown, and individual discretion is required based on the setting, the patient population and other factors. A facility may choose to discontinue isolation precautions once the patient is reasonably well, continent of stool and capable of self-care with good hygiene. **(Category C)**

g. A system should be established to permit identification of patients positive for multi-resistant organisms (e.g., MRSA, VRE) who are admitted, readmitted, or transferred to health care facilities. Consideration should be given to screening patients admitted from VRE endemic regions. Communication between infection control personnel upon transfer to other facilities (including long-term care, chronic care) is essential. **(Category B; Grade III)**

h. Policies must be in place for the thorough cleaning and disinfection of environmental surfaces (bed rails, call bells, bedside tables, commodes, bathrooms) that may have been contaminated[16,43,63,68,86]. Detergents or low level disinfectants are effective for cleaning when special attention is given to visibly soiled areas. Communication with housekeeping, nursing and administrative personnel is of particular importance in this setting[79]. **(Category B; Grade III)**

i. Transfers to other facilities such as long term care, rehabilitation, or other acute care facilities should not be delayed for patients who are colonized or infected with VRE. The facility receiving the patient should be notified that the patient has VRE. It should be able to provide appropriate isolation and care based on the assessment of the individual patient (as outlined in recommendations **a** to **d**) and the type of setting (acute care facility, rehabilitation centre, nursing home). Health care workers in long-term care, nursing homes, and rehabilitation facilities can refer to these guidelines or the long term care guidelines[87] for further assistance. **(Category B; Grade III)**

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APPENDIX — Guideline Rating System

A. Previous Rating System for Statements

In the Laboratory Centre for Disease Control (LCDC) Infection Control Guidelines a system was previously used for rating guideline statements according to the strength of evidence[88,89]. Each statement was rated into one of three categories:

Category I: Strongly recommended for adoption

Measures in Category I are strongly supported by well-designed and controlled clinical studies that show effectiveness in reducing risk of nosocomial infections or are viewed as useful by the majority of experts in the field. Measures in this category are judged to be applicable to the majority of facilities regardless of size, patient population, or endemic nosocomial infection rate and are considered practical to implement.

Category II: Moderately recommended for adoption

Measures in Category II are supported by highly suggestive clinical studies or by definitive studies in specialized institutions that might not be representative of other facilities. Measures that have not been adequately studied, but have a strong theoretical rationale indicating that they might be very effective, are included in this category. Category II measures are judged to be practical to implement but not considered a standard of practice for every setting.

Category III: Weakly recommended for adoption

Measures in Category III have been proposed by some investigators, authorities or organizations, but, to date, lack both supporting data and strong theoretical rationale. Thus, they may be considered as important issues requiring further evaluation by those who wish to implement them.

B. Current Rating System for Statements

A more elaborate system of rating has been recently proposed[90], with five categories to rank the strength of evidence *for* (categories A-C) or *against* (D-E) a statement, and three grades to describe the quality of supportive studies. This system of rating follows the guidelines that have been recently published[90] for clinical practice guidelines. The format uses an evidence-based medicine approach, which stresses the examination of evidence from clinical research, especially randomized studies, and places less emphasis on intuition and recalled experiences.

This new rating scheme, with one modification, is used in this document with appropriate clarification of evidence described in the text. The modification occurs in Category C with the word "insufficient" replacing "poor" in the original rating scheme. This system is outlined in the following table.

Strength and Quality of Evidence for Recommendations

Categories for strength of each recommendation

CATEGORY	DEFINITION
A	Good evidence to support a recommendation for use.
B	Moderate evidence to support a recommendation for use.
C	Insufficient evidence to support a recommendation for or against use.
D	Moderate evidence to support a recommendation against use.
E	Good evidence to support a recommendation against use.

Categories for quality of evidence on which recommendations are made

GRADE	DEFINITION
I	Evidence from at least one properly randomized, controlled trial.
II	Evidence from at least one well-designed clinical trial without randomization, from cohort or case-controlled analytic studies, preferably from more than one centre, from multiple time series, or from dramatic results in uncontrolled experiments.
III	Evidence from opinions of respected authorities on the basis of clinical experience, descriptive studies, or reports of expert committees.

The information in these guidelines was current at the time of publication; it should be emphasized that areas of knowledge and aspects of medical technology advance with time. Guidelines, by definition, are directing principles and indications or outlines of policy or conduct, which should not be regarded as rigid standards. These guidelines should facilitate development of standards but respect the autonomy of organizations and recognize their governing body's authority and responsibility to ensure the quality of care provided to their patients.

FOOT CARE BY HEALTH CARE PROVIDERS

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Ontario Society of Chiropodists

Ontario Podiatry Association

College of Nurses of Ontario

Manitoba Association of Chiropodists

Saskatchewan Association of Chiropodists

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Introduction

Guidelines, by definition, are directing principles and indications or outlines of policy or conduct, and should not be regarded as rigid standards. These Guidelines should facilitate development of standards but respect the autonomy of organizations and recognize their governing bodies' authority and responsibility to ensure the quality of care provided to their patients/clients.

The guidelines in this document are intended for use by health care providers, including registered nurses, licensed practical nurses, and registered practical nurses, performing routine foot care that is not intentionally invasive. The settings for the provision of foot care may include locations such as the home, seniors lodges, community residences, or continuing and acute care facilities.

Health care providers must follow the scope of practice, standards and regulations of their professional regulatory body in the province in which they are practising (e.g., for nurses providing foot care in Ontario, refer to *Nursing Foot Care Standards* of the College of Nurses of Ontario).

The number of persons requiring assistance with the care of their feet is increasing with the rising number of elderly persons in the population. The Victorian Order of Nurses for Canada (VON) has estimated that between 15% and 20% of Canadians over the age of 65 who live at home require assistance with care of their feet[1]. Inadequate foot care, which may produce foot problems such as ulcers or infections, can result in pain and decreased mobility[2,3]. This may lead to a sedentary lifestyle, which has been associated with cerebrovascular disease and impaired cognition[4]. The results of a survey conducted by the VON following the nation wide project *Keeping Canadians on their Feet*[1] revealed that 69.8% of people receiving foot care reported that it helped them to walk.

A. Causes of Common Foot Infections

The origins of common foot disorders can be classified into three broad categories: biomechanical factors (e.g., defects in foot architecture, direct trauma); manifestations of underlying general and systemic disease (e.g., diabetes, arteriosclerosis); and infections (e.g., Athlete's foot, cellulitis). Foot infections may be bacterial, viral, or mycotic (fungal)[3].

B. Foot Problems in Persons Living with Diabetes

Of all the causes of foot pathology, diabetes has undisputed importance. People living with diabetes are vulnerable to foot problems associated with peripheral vascular disease and neuropathy, producing a decreased sensation to pain and touch[5]. Diabetes has been diagnosed in 8 million Americans[6] and 1.5 million Canadians[7]. Diabetic foot infections are the most common reason for admission to hospital in persons with diabetes. In the U.S., the direct costs of admissions for foot infections in 1983 exceeded $43 million[8]. More than half of all amputations in the United States from 1989 to 1992 occurred in people with diabetes; an average of 54,000 amputations were performed each year[7]. In Ontario, 45% of all amputations of a lower extremity occur in patients with diabetes, even though these people constitute approximately 5% of the population[9]. One group of researchers reported that the development of ulcers as a result of minor trauma, such as an accidental cut from the use of improper footwear, preceded 86% of amputations. Unsafe nail and foot care practices have been shown to contribute to foot trauma[10]. It has been estimated that half of all foot amputations can be averted by the prevention, early detection, and treatment of foot infections[11,12].

C. Risk of Infection Following Foot Care

Infection prevention/control standards for health care providers in the routine care of the feet and nails could not be located in published form. A literature review from 1980 to the present using the databases Medline and Cinahl resulted in little information regarding the source of infections precipitated by routine foot care. A selected Internet search for information on foot care/infections found the primary focus to be foot infections associated with diabetes. A plethora of literature exists on medical interventions for foot infections, and the nursing literature tends to focus on foot assessment, care of the feet and nails, and patient education.

Sources and Reservoirs of Foot Infection

The microflora of the foot include organisms that are resident (those that normally inhabit the skin) and those that are transient (those that have been deposited on the skin). People who have been cared for in health care institutions or who have damaged tissue have a greater risk of being colonized with organisms that are not normally found on the foot[13]. Approximately 50% of the population have athlete's foot infection some time in their life[14]. Micro-organisms may be transmitted from person to person by direct contact, usually through the hands of health care providers[13,15], or indirect contact (by a vehicle such as foot care equipment)[13]. Sources of infection can be divided into the following two categories:

i. **endogenous sources**: caused by flora or infection on the person's own body (e.g., *Staphylococcus aureus* from the nose or *Corynebacterium minutissimum* from the skin).

ii. **exogenous sources**: caused by infected or colonized people or animals and environmental sources (e.g., flora from others such as *S. aureus* or infections from animals such as *Microsporum canis*)[16].

Viruses present in the blood of persons receiving foot care may also create a risk of infection for others. Of greatest concern are the bloodborne pathogens hepatitis B virus (HBV), hepatitis C virus (HCV), and the human immunodeficiency virus (HIV)[16]. Because sharp instruments used during foot care may puncture the skin and become contaminated with blood, they must be appropriately cleaned and sterilized between use. Sterilization destroys all forms of microbial life. Any microorganism that comes into contact with a mucous membrane, skin that is not intact, sterile tissue, or the vascular system has the potential to cause infection. Instruments used in foot care that may break the skin must be sterile.

Foot Care Equipment

Foot care equipment is transported in the nurse's carrying bag to the foot care site. The assembled foot care equipment should contain:

- a set of sterilized foot care instruments for each patient/client
- disposable paper towel on which to place instruments during procedure
- commercial puncture-proof sharps container
- skin antiseptic
- hand washing soap and disposable towels
- waterless hand washing agent
- container to transport used instruments
- one pair of non-sterile medical gloves (latex, vinyl, nitrile etc.) for each patient/client
- foot emollient (lotion or cream)
- protective equipment (eye shield, disposable face mask and disposable apron, gown or towel)
- sterile gauze or Band-Aid®

Cleaning Foot Care Equipment

All items should be washed in warm water with a detergent. Personnel who are cleaning the equipment should wear general purpose household gloves. Files and hinged instruments should be cleaned with a small brush (e.g. toothbrush) while the instrument is held under water to prevent splashing. An ultrasonic cleaning device may be used as an additional step in the cleaning process. Washed items should be left to dry. Cleaned instruments should be placed in packaged sets prior to sterilization.

Recommendations

The overall goal of infection prevention practices for foot care is to eliminate the risk of the transmission of pathogens between clients and between clients and the health care worker. Foot trauma during the foot care procedure should be avoided to eliminate the client risk of acquiring infections. The following recommendations should be implemented when providing foot care.

a. All foot care equipment for re-use must be capable of being cleaned in a detergent and water to remove organic matter.

b. Single-use items such as emery boards, orange sticks and rotary tool disks should be discarded after use. If a client's own equipment is used, it must be kept clean and dry.

c. **All instruments used in foot care must be sterile** before use on a client/patient. Instruments that must be sterilized prior to use, often packaged in sets, may include the following:

- nail nippers
- foot dresser file
- Black's file
- rasp
- scalpel handle (for attachment of blade)
- nail probe
- callus parer

d. The recommended methods of sterilization for foot care instruments include dry heat; autoclave (steam under pressure); or chemisterilant with exposure time as stated on product's label. Methods of cleaning, disinfection and sterilization are detailed in text and tabular form in the Health Canada publication *Infection Control Guidelines for Cleaning, Disinfection, Sterilization and Antisepsis in Health Care*[17].

e. Glass bead sterilization is not an effective method of sterilization and should not be used[17-19].

f. Boiling water[20] and microwave ovens are not effective methods of sterilization and should not be used[17].

g. Hand washing is the single most important procedure for preventing infections[17]. Hands must be washed with soap and water before beginning the foot care procedure. Hands should be washed before glove use and after glove removal. Foot care clinics should be arranged with consideration for the availability of hand washing sinks. Waterless hand washing agents may be used if a sink is not available[17].

h. Non-sterile medical gloves should be worn throughout the procedure to prevent exposure to bacteria, fungi and viruses[21].

i. Gloves must be changed for each patient. The hands should not be washed with gloves on.

j. Eye shields or glasses should be worn to protect the health care provider from nail clippings or debris[17,21].

k. A disposable face mask should be worn to reduce the possibility of inhaling organisms that may be aerosolized during filing of nails. The inhalation of nail dust has been associated with conditions such as conjunctivitis, rhinitis, and an occupational lung disease called "podiatrist's lung"[22-24]. Masks should fit snugly and be worn for one patient/client only.

l. If the foot of the person receiving care is positioned on the lap of the health care provider, the clothing of the health care provider should be protected by a disposable gown, apron, or a clean towel.

m. The use of a foot soak prior to foot care is controversial[25]; however, the feet should be clean. Feet should be washed with a mild soap and warm water. If the foot basin is used it should be washed with soap and water, rinsed, and dried thoroughly between clients.

n. A skin antiseptic should be used to wipe areas of the feet that will be touched by a foot care instrument (e.g., before removing calluses). If cotton balls are used, a disposable container should be used to wet the cotton balls with the antiseptic. Alternatively, prepackaged swabs should be used.

o. Emollients, such as lotions/creams, are often used to massage and moisturize the foot[26]. It is desirable to use small, single use lotion bottles that can be left with the client[17]. If the bottle containing the lotion is used on more than one client, care must be taken to keep the contents free from contaminants. Squeeze the lotion

onto the gloved hand without touching the bottle opening.

p. If towels are used during foot care clinics, the towel should be used for one client only. Clients should not walk with bare feet. Plantar warts are more frequently associated with users of public showers, sports centres, and gymnasia[27,28].

q. If the integrity of the skin is accidentally breached, the area should be wiped with a skin antiseptic and covered with a loosely applied sterile gauze or a Band-Aid®. Constrictive adhesive dressings should not be applied to toes[29]. A protocol should be developed for the daily monitoring and documenting of the wound healing process.

r. If used, blades on foot care instruments should be disposed of in appropriate sharps containers at the completion of each foot care treatment. Blades must not be re-used.

s. All health care workers providing foot care should be aware of protocols for the prevention of the transmission of bloodborne pathogens, e.g., recommendations for hepatitis B immunization and management of accidental exposure to blood[30-32].

Summary

These recommendations have been provided to assist health care providers in performing foot care with the intention of decreasing the transmission of pathogens and resulting infections. It is important that providers of foot care implement these recommendations into their daily practice so that infections associated with foot care can be prevented.

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