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Infection Control Guidelines

Prevention and Control of Occupational Infections in Health Care

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Infection Control Guidelines

Prevention and Control of Occupational Infections in Health Care

Division of Nosocomial and Occupational Infections
Bureau of Infectious Diseases
Centre for Infectious Disease Prevention and Control
Population and Public Health Branch
Health Canada

Introductory Statement

The primary objective in developing clinical guidelines at the national level is to help health care professionals improve the quality of health 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, by definition, are directing principles and indications or outlines of policy or conduct that should not be regarded as rigid standards. Guidelines facilitate the setting of standards but respect the autonomy of each health care setting and recognize the governing body's authority and responsibility to ensure the quality of care provided. Personnel in health care settings should also be aware of the regulations and policies in their local and provincial/territorial area regarding infectious diseases.

The Health Canada Infection Control Guidelines have been based, whenever possible, on research findings. Sometimes published research is insufficient, and the consensus of experts in the field has therefore been used to provide guidelines specific to conventional practice[1]. 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. 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 were developed.

The Steering Committee acknowledges, with sincere appreciation, the many practising health professionals and others who contributed advice and information to this endeavour. Health Canada is especially appreciative of the time and expertise contributed by the Subcommittee for the *Prevention and Control of Occupational Infections in Health Care,* which worked diligently and successfully to develop these extensive guidelines.

[1] See Appendix I: Guideline Evidence-Based Rating System

The guidelines outlined below are part of the Health Canada *Infection Control Guidelines* series that has been developed over a period of years under the guidance of the Infection Control Steering Committee. *Prevention and Control of Occupational Infections in Health Care* replaces *Occupational Health in Health Care Facilities* (1990). The new guideline presents an overview and provides recommendations to assist in the prevention and management of health care worker exposures and infections in health care. It is intended to be used with the other *Infection Control Guidelines*[2] and relevant Health Canada documents that are published in the Canada Communicable Disease Report. These include the following:

- *Essential Resources for Infection Control Effectiveness* (in preparation)(1)
- *Creutzfeldt-Jakob Disease (CJD) in Canada* (in preparation)(2)
- *Construction-related Nosocomial Infections for Patients in Health Care Facilities: Decreasing the Risk of Aspergillus, Legionella and other Infections* (2001)(3)
- *Routine Practices and Additional Precautions for Preventing Transmission of Infection in Health Care* (1999)(4)
- *Infection Prevention and Control Practices for Personal Services: Tattooing, Ear/Body Piercing, and Electrolysis* (1999)(5)
- *Hepatitis C - Prevention and Control: A Public Health Consensus* (1999)(6)
- *Proceedings of the National Varicella Consensus Conference* (1999)(7)
- *Canadian Immunization Guide,* 5th edition (1998)(8)
- *Proceedings of the Consensus Conference on Infected Health Care Workers: Risk of Transmission of Bloodborne Pathogens* (1998)(9)
- *Hand Washing, Cleaning, Disinfection and Sterilization in Health Care* (1998)(10)
- *Preventing the Transmission of Bloodborne Pathogens in Health Care and Public Services Settings* (1997)(11)
- *An Integrated Protocol to Manage Health Care Workers Exposed to Bloodborne Pathogens* (1997)(12)
- *Canadian Contingency Plan for Viral Hemorrhagic Fevers and Other Related Diseases* (1997), produced by the Office of Special Health Initiatives(13)
- *Preventing the Spread of Vancomycin-Resistant Enterococci (VRE) in Canada* (1997)(14)
- *Foot Care by Health Care Providers* (1997)(15)
- *Preventing Infections Associated with Indwelling Intravascular Access Devices* (1997)(16)
- *Preventing the Transmission of Tuberculosis in Canadian Health Care Facilities and Other Institutional Settings* (1996)(17)
- *Laboratory Biosafety Guidelines*. 2nd edition (1996), produced by the Office of Biosafety(18)
- *A National Consensus on Guidelines for Establishment of a Post-Exposure Notification Protocol for Emergency Responders* (1995)(19)

[2] For an ongoing update of the *Infection Control Guidelines* series, please view the Health Canada Web site at http://www.hc-sc.gc.ca/pphb-dgspsp/dpg_e.html#infection.

- *National Symposium on Risk and Prevention of Infectious Diseases for Emergency Response Personnel* (1994)[20]
- *Long Term Care Facilities* (1994)[21]
- *Organization of Infection Control Programs in Health Care Facilities* (1990)[22]

For information regarding the above Health Canada publications, contact:

Division of Nosocomial and Occupational Infections
Bureau of Infectious Diseases
Centre for Infectious Disease Prevention and Control
Health Canada, PL 0603E1
Ottawa, Ontario K1A 0L2
Telephone: (613) 952-9875
Fax: (613) 998-6413

Web site URL:
<http://www.hc-sc.gc.ca/pphb-dgspsp/dpg_e.html#infection>

Steering Committee on Infection Control Guidelines

Steering Committee Members

Dr. Lindsay Nicolle (Chair)
H.E. Sellers Professor and Chair
Department of Internal Medicine
University of Manitoba Health Sciences Centre
GC 430, 820 Sherbrooke St.
Winnipeg, MB R3A 1R9
Tel: (204) 787-7772 Fax: (204) 787-3159
E-mail: lnicolle@hsc.mb.ca

Dr. John Conly
Hosp. Epidemiologist and Assoc. Prof. of Medicine
Department of Mircobiology
The Toronto Hospital
200 Elizabeth, Rm 117-NU13
Toronto, ON M5G 2C4
Tel: (416) 340-4858 Fax: (416) 340-5047
E-mail: john.conly@uhn.on.ca

Dr. Charles Frenette
Hospital Epidemiologist and Chief of Microbiology
Hôpital Charles LeMoyne
Sherbrooke University
3120 boul. Tachereau
Greenfield Park, QC J4V 2H1
Tel: (450) 466-5000 Fax: (450) 466-5778
E-mail: c.frenette@ssss.gouv.qc.ca

Ms. Colleen Hawes
Simon Fraser Health Region
330 E Columbia Street
New Westminster, BC V3L 3W7
Tel: (604) 520-4730 Fax: (604) 520-4724
E-mail: colleen_hawes@sfhr.hnet.bc.ca

Dr. Lynn Johnston
Hosp. Epidemiologist and Assoc. Prof. of Medicine
QEII Health Science Centre
Rm. 5-014 ACC, 1278 Tower Road
Halifax, NS B3H 2Y9
Tel: (902) 473-7003 Fax:(902) 473-7394
E-mail: ljohnsto@is.dal.ca

Ms. Linda Kingsbury
Nurse Consultant
Div. of Nosocomial and Occupational Infections
Health Canada
Tunney's Pasture, PL 0603E1
Ottawa, ON K1A 0L2
Tel: (613) 957-0328 Fax: (613) 998-6413
E-mail: linda_kingsbury@hc-sc.gc.ca

Dr. Dorothy Moore
Division of Infectious Diseases
Montreal Children's Hospital
2300 Tupper, Rm C-1242
Montreal, QC H3H 1P3
Tel: (514) 934-4485 Fax: (514) 934-4494
E-mail: dorothy.moore@muhc.mcgill.ca

Ms. Deborah Norton
Infection Control Practitioner
Regina General Hospital
1440-14th Ave.
Regina, SK S4P 0W5
Tel: (306) 766-4471 Fax: (306) 766-4640
E-mail: dnorton@reginahealth.sk.ca

Ms. Laurie O'Neil
Infection Prevention and Control Consultant
1819 Cayuga Cres. NW
Calgary, AB T2L 0N7
Tel:(403) 282-2340 Fax:(403) 282-2090
E-mail: laurieoneil@home.com

Ms. Shirley Paton
Chief, Div. of Nosocomial and Occupational Infections
Bureau of Infectious Diseases
Health Canada
Tunney's Pasture, PL 0603E1
Ottawa, ON K1A 0L2
Tel: (613) 957-0326 Fax: (613) 998-6413
E-mail: shirley_paton@hc-sc.gc.ca

Ms. Diane Phippen
Epidemiologist Nurse Coordinator
Manitoba Health
Cadham Provincial Laboratory
Box 8450, 750 William Ave.
Winnipeg, MB R3C 3Y1
Tel: (204) 945-6685 Fax: (204) 786-4770
E-mail: dphippen@gov.mb.ca

Ms. Filomena Pietrangelo
Occupational Health Counsellor
Montreal General Hospital
Occupation Health and Safety Department
Rm T6-201, 1650 Cedar Ave.
Montreal, QC H3G 1A4
Tel: (514) 937-6011 Fax: (514) 934-8274
E-mail: filomena.pietrangelo@muhc.mcgill.ca

Dr. Geoffrey Taylor
Dept. of Medicine, Div. of Infectious Diseases
2E4.11 Walter McKenzie Centre
Edmonton, AB T6G 2B7
Tel: (780) 407-7786 Fax: (780) 407-7137
E-mail: taylorg@gpu.srv.ualberta.ca

Dr. Dick Zoutman
Director, Infection Control Services
Kingston General Hospital
76 Stuart St.
Kingston, ON K7L 2V7
Tel: (613) 549-6666 Fax: (613) 548-2513
E-mail: zoutman@cliff.path.queensu.ca

Liaison Members

Ms. Joni Boyd
Nursing Policy Consultant
Canadian Nurses' Association
50 The Driveway
Ottawa, ON K2P 1E2
Tel: (613) 237-2133 Fax: (613) 237-3520
E-mail: jboyd@cna-nurses.ca

Dr. Elizabeth Bryce
Director, Standards and Guidelines
Department of Microbiology
Vancouver General Hospital
University of British Columbia
855 West — 12th Avenue
Vancouver, BC V5Z 1M9
Tel.: (604) 875-4759
Fax: (604) 875-4359
E-mail: ebryce@vanhosp.bc.ca

Ms. Monique Delorme
APPI
Hôpital Charles LeMoyne
Sherbrooke University
3120 boul. Tachereau
Greenfield Park, QC J4V 2H1
Tel: (450) 466-5000 Fax: (450) 466-5778
E-mail: monique.delorme@rrsss16.gouv.qc.ca

Dr. John Embil
Canadian Healthcare Association
Director, Infection Control Unit
Health Sciences Centre
820 Sherbrooke St., MS673
Winnipeg, MB R3A 1R9
Tel: (204) 787-4654 Fax: (204) 787-4699
E-mail: jembil@hsc.mb.ca

Dr. Pierre St-Antoine
AMMIQ
Centre hospitalier de l'Université de Montréal
Pavillon Notre-Dame
1560, rue Sherbrooke Est
Montreal, QC H2I 4M1
Tel: (514) 281-6000 Fax: (514) 896-4607
E-mail: pierre.st-antoine@umontreal.ca

Mrs. Belva Taylor
Assistant Executive Director
Canadian Council on Health Accreditation
1730 St. Laurent Blvd, Suite 100
Ottawa, ON K1G 5L1
Tel: (613) 738-3800 Fax: (613) 738-3755
E-mail: tayb@cchsa.ca

Dr. Mary Vearncombe
CACMID
Hospital Epidemiologist
Sunnybrook & Women's College Health Sciences Ctr
76 Grenville St
Toronto, ON M5S 1B2
Tel: (416) 323-6278 Fax: (416) 323-6116
E-mail: mary.vearncombe@swchsc.on.ca

Ex-officio Member

Dr. John Spika
Former Director, Bureau of Infectious Diseases
Centre for Infectious Disease Prevention and Control
Population and Public Health Branch
Health Canada
Tunney's Pasture, PL 0603E1
Ottawa, ON K1A 0L2
Tel: (613) 957-4243 Fax: (613) 998-6413
E-mail: john_spika@hc-sc.gc.ca

Subcommittee for Prevention and Control of Occupational Infections in Health Care

Ms. Diane Phippen (Chair)
Epidemiologist Nurse Coordinator
Manitoba Health
Cadham Provincial Laboratory
Box 8450, 750 William Ave.
Winnipeg, MB R3C 3Y1
Tel: (204) 945-6685 Fax: (204) 786-4770
E-mail: dphippen@gov.mb.ca

Dr. Mark Bigham
Epidemiologist
BC Centre for Disease Control
655 West 12th Avenue
Vancouver, BC V5Z 4R4
Tel: (604) 660-6061 Fax: (604) 660-0197
E-mail: mark.bigham@bccdc.hnet.bc.ca

Ms. Eleanor Gilding
Manager, OH&S Education
Central Vancouver Island Health Region
c/o Chemainus Health Care Centre
9909 Esplanade Street, P.O. Box 499
Chemainus, BC V0R 1K0
Tel: (250) 246-3291 Fax: (250) 246-3844
E-mail: eleanor.gilding@cvihr.bc.ca

Ms. Brenda Marsh
Occupational Health Specialist
5 Hershey Road
Dartmouth, NS B2Y 2H4
Tel: (902) 465-7474 Fax: (902) 424-0606
E-mail: jlmarsh@netcom.ca

Ms. Myrna McGill
Office Manager
Health Sciences Centre
Dept. of Occupational and Environmental Medicine
N618-700 McDermot Ave.
Winnipeg, MB
Tel: (204) 787-4390 Fax: (204) 787-1172
E-mail: mmcgill@exchange.hsc.mb.ca

Ms. Laurie O'Neil
Infection Prevention and Control Consultant
1819 Cayuga Cres. NW
Calgary, AB T2L 0N7
Tel: (403) 282-2340 Fax: (403) 282-2090
E-mail: laurieoneil@home.com

Ms. Sharon Onno
Nurse Epidemiologist – Occupational Infections
Division of Nosocomial and Occupational Infections
Health Canada
Tunney's Pasture, PL 0603E1
Ottawa, ON K1A 0L2
Tel: (613) 954-4869 Fax: (613) 998-6413
E-mail: sharon_onno@hc-sc.gc.ca

Ms. Filomena Pietrangelo
Occupational Health Counsellor
Montreal General Hospital
Occupational Health and Safety Department
Rm T6-201, 1650 Cedar Ave.
Montreal, QC H4G 1A4
Tel: (514) 937-6011 Fax: (514) 934-8274
E-mail: filomena.pietrangelo@muhc.mcgill.ca

Ms. JoAnne Seglie
Occupational Health Officer
University of Alberta
Environmental Health and Safety
107 Education Car Park
Edmonton, AB
Tel: (780) 492-5378 Fax: (780) 492-7790
E-mail: joanne.seglie@ualberta.ca

Executive Summary

The Guideline for the *Prevention and Control of Occupational Infections in Health Care* (2002), is one in the series of Infection Control Guidelines for health care personnel prepared by Health Canada's Division of Nosocomial and Occupational Infections. It is designed to assist occupational health (OH) practitioners, medical directors and others responsible for infectious diseases that affect health care workers (HCWs). This guideline is primarily intended for hospitals and long-term care facilities and may be useful for home care and community health workers, contract services, daycare or correctional service workers. This Guideline makes frequent reference to a companion Guideline, *Routine Practices and Additional Precautions for Preventing the Transmission of Infection in Health Care*. This companion Guideline provides a comprehensive list of infectious diseases and precautions necessary to prevent transmission when providing patient care.

This Guideline presents an overview of occupational infections in health care and provides recommendations to assist in the prevention and management of HCWs' exposures to, and infections with, infectious diseases. It updates and replaces recommendations from the previous document, *Occupational Health in Health Care Facilities* (1990) by reflecting the four principles of OH programs (risk assessment, risk control measures, education, and evaluation).

Recommendations are based on the most current literature and the consensus of the *Working Committee for Prevention and Control of Occupational Infection in Health Care.* Since literature is frequently updated and public health legislation supercedes these recommendations, the user should also consult new information and local public health officials to ensure the recommendations' applicability to local practices. This guideline:

1) supports the essential collaboration between OH programs and Infection Control programs;

2) focuses on infectious diseases for which there is evidence that person-to-person transmission has occurred through occupational exposure;

3) addresses occupational infections that may occur during the delivery of health care.

Section A. " Recommendations for Infection Prevention and Control Components of an Occupational Health Program" outlines the foundations of an effective OH program with particular focus on prevention, health promotion, and reduction of health hazards in health care settings. Major attention is given to the assessment of infectious disease hazards.

Section B. "Recommendations for Diseases of Significance to Occupational Health" augments the general risk assessment of Section A with disease specific analyses. Risk Control Measures provides recommendations for HCWs who are symptomatic, colonized, or infected with a communicable disease, independent of an occupational exposure. To assist the user to identify a true exposure or infection in order to clarify management, Criteria to Confirm the Diagnosis have been provided with each disease.

When applicable, disease specific recommendations are made. Cited evidence is based on literature pertinent to health care and more specifically to the HCW. General recommendations for prophylaxis and treatment are current at the time of publication. Because of the rapid changes in drug regimens, specific medication recommendations have not been made and the user is referred to current literature.

Both sections A and B contain recommendations for actions by the individuals who have responsibility for OH programs, i.e., OH or administration. Statements regarding essential infrastructure and resources for the program are clearly identified.

An **algorithm** (see page 6) " Occupational Health Management Strategy for Infectious Diseases in HCWs" clarifies the roles and responsibilities of OH, Administration and the HCW for the user and outlines the path for management of infection-related issues.

Section C. "Health Care Worker Immunization and Recommendations" adapts information from Health Canada's *Canadian Immunization Guide* and published recommendations from the National Advisory Committee on Immunization (NACI) about vaccine-preventable diseases pertinent to OH in health care settings. Maintenance of immunity against vaccine-preventable diseases is identified as an integral part of an OH program.

Section D. The "Summary Table" is a quick reference of the disease-specific information presented in Section B. The Table includes exposure definitions and identifies prophylaxis, treatment and/or work restrictions.

Appendix I. The "*Guideline Evidence-Based Rating System*" describes the system of ranking the strength of the evidence that exists with respect to recommendations made in the guideline.

Appendix II. The "Literature Review of Bloodborne Pathogen Exposures to Health Care Workers and their Control Measures" describes the incidence of sharp, mucocutaneous and bite exposures among HCWs that puts them at risk for acquiring bloodborne pathogens in addition to the effectiveness of control measures.

Appendix III. The "*Canadian Needle Stick Surveillance System (CNSSN)"* outlines the surveillance protocol, results of the analysis of one year's data and future plans of the CNSSN.

The Health Canada guidelines are available for all those involved in preventing transmission of infection in today's changing health care environment. They are available on the Population and Public Health Branch web site (www.hc-sc.gc.ca/pphb-dgspsp/publicat/ccdr-rmtc/). Printed copies are available from the Canadian Medical Association at 1-888-855-2555. For further information, please contact the Division of Nosocomial and Occupational Infections at 613-952-9875.

Table of Contents

Preamble

The purpose of an Occupational Health (OH) program is to promote the health and well-being of employees by providing a safe and healthy workplace, to prevent or decrease transmission of infection to or from health care workers due to workplace hazards, including biohazards, and to adhere to legislation. A component of the OH program relates specifically to infection control and must be planned and delivered in collaboration with the Infection Control (IC) program of the workplace. While this document supports the close collaboration of OH personnel with those responsible for the IC program, it does not discuss measures that IC practitioners use to assess and control infections in the patient population. Rather, it notes the essential collaboration of both groups working together where responsibilities overlap, especially in the management of outbreaks. Various workplaces will define the distinct roles of OH and IC practitioners differently to suit their health care environment.

In addition to the existing *Organization of Infection Control Programs in Health Care Facilities*[22] and *Long Term Care Facilities*[21], a complementary document on *Essential Resources for Infection Control Effectiveness*[1], including the IC practitioner as a major resource, is in draft form and will be published upon completion. Thus *Prevention and Control of Occupational Infections in Health Care* recognizes that collaboration is essential and encourages OH to coordinate its IC-related activities with key partners, in particular from IC but also from administration, laboratories, educational services, environmental services, maintenance, purchasing and product evaluation, health and safety committees, and public health authorities, to achieve its infection control objectives.

In recent years, the delivery of health care services has undergone substantial change. Regionalization of health care delivery, increasing rates of day surgery, increased acuity of illness of patients in health care facilities, an aging work force, transition of care from hospitals to the community, employees who work part time in more than one institution, and students from a variety of teaching institutions

have become the norm. These changes influence how the health care setting in general, and the OH program specifically, delivers programs.

Occupational infections may occur in the delivery of health care and are acquired by health care workers from various sources in their workplace, e.g. an infected individual or contaminated equipment or environment. For the purpose of this document the term *health care worker* (HCW) will be used to include any individual who has the potential to acquire or transmit infectious agents during the course of his or her work in health care and includes students, e.g. nurses, residents, doctors, and researchers. Volunteers and emergency responders who have direct patient contact should be considered as HCWs and included in the process of postexposure management. The term *patient* will include any individual who receives health care irrespective of the type of setting/service. Nosocomial infections, acquired by patients as a result of receiving health care, are under the purview of IC and therefore outside the jurisdiction of this document and are not discussed.

This document is designed to assist individuals, especially OH practitioners and medical directors, who are responsible for infection control issues that affect HCWs. The document is primarily intended for hospitals and long-term care facilities, and although not intended to specifically address home care and community health workers, contract services, day care, or correctional service workers, the information may be useful in those settings. It remains the responsibility of each workplace administration to ensure that an OH program is in place that includes appropriate policies and procedures and that it is applicable to the specific health care setting and the resource allocations. The OH staff of each health care workplace must ensure that workers employed by others but working within its jurisdiction, such as contractors or those from other educational facilities, meet the OH requirements of their workplace. Each workplace administration must also ensure access to appropriate medical resources for the OH program through either an internal or external referral process.

The format of the revision of *Occupational Health in Health Care Facilities* (1990) has been changed to reflect the principles of OH programs as outlined by four components: *risk assessment, risk control measures*, *education* and *evaluation*. A template (see Table I on page 5) is used in Sections A and B to assist the reader in addressing all aspects of these components.

Section A – the foundation of an effective OH program is prevention based on sound risk assessment. Section A includes general risk assessment and recommendations that should be implemented by all employers in order to prevent or minimize occupational exposures to infectious diseases.

Section B – it is inevitable that there will be occasions when a HCW is either infected with or exposed to an infectious disease. Section B is intended to augment the general prevention recommendations of Section A with recommendations on risk assessment, and prevention and management specific to the particular disease. Variables related to risk — e.g. circumstances of exposure, use of Personal Protective Equipment, likelihood of transmission — must be considered in determining the appropriate management. Section B should never be used without implementation of Section A.

Evidence cited in Section B-1.2 does not reflect the exhaustive body of literature available but, rather, that which is pertinent to health care and more specifically to the HCW. For vaccine preventable diseases, evidence regarding vaccine will be found in this section as well.

Section C – this summarizes the Canadian recommendations for immunization and augments the Administrative Control recommendations in Section A-2.1.3.6.

Section D – this is a summary table of the diseases in Section B outlining exposure definitions and the need for prophylaxis, treatment and/or work restrictions. It is intended as a guide to the more detailed information in the text of Section B.

Sections A and B – these contain recommendations for action by the individuals who have responsibility for OH programs, and they frequently start with the wording, "OH should …". Since infrastructure and resources are essential to the OH program, some statements will reflect this by the wording, "Administration should …".

The document focuses on infectious diseases for which there is evidence that person-to-person transmission has occurred in the context of occupational exposure. Most infectious diseases are addressed individually; however, some will appear as the following:

- *Grouped Diseases/Infections* – certain types of infections have similar information and management approaches. Since so much information is similar, they are considered under the categories of Hepatitis A Virus/Hepatitis E Virus, Gastroenteric Infections, Respiratory Infections, and Bloodborne Pathogens. Where disease-specific evidence or recommendations are necessary within the category, these will be stated.
- *Referred Diseases* – when particular diseases are already the focus of published *Infection Control Guidelines* the reader is referred to them for detailed information beyond the scope of this document. These include Creutzfeldt-Jakob disease, tuberculosis, viral hemorrhagic fevers, and bloodborne pathogens. The companion documents that should be available for use in conjunction with this document are listed on page iv.
- *Zoonotic and Arboviral Diseases* – most do not require OH management. Rabies and malaria appear in the tables only, and the reader is referred to an infectious diseases specialist and/or public health authorities.

Other infectious diseases have not been addressed for the following reasons:

- *There has been no person-to-person transmission documented in Canada* – for several infectious diseases there is no evidence of person-to-person transmission, even though such diseases are diagnosed in patients in Canadian health care facilities, e.g. aspergillosis, legionellosis, toxoplasmosis, hantavirus, arboviruses. These are therefore not considered to be a risk for acquisition in the health care setting.
- *There is no evidence of person-to-person transmission in the context of occupational health* – infectious diseases, e.g. those resulting from *Helicobacter pylori*, human papillomavirus and Candida, though transmissible from person to person, have not been shown to be transmitted to or from HCWs.
- *There is insufficient information and/or areas are developing* – a variety of infectious agents, e.g. those causing tropical diseases, moulds, xenozoonoses, gene therapy, may occasionally be encountered in the occupational health context. The risk of transmission to HCWs is not yet known. As new information becomes available regarding these risks, existing guidelines will need to

be modified. However, information at present is not definitive, and specific recommendations cannot be made.

- *They are uncommon* – many infectious diseases, e.g. cholera, schistosomiasis, are uncommon in Canadian health care delivery, and other literature should be consulted.

In this document, *Prevention and Control of Occupational Infections in Health Care*, there is frequent reference to the companion document, *Routine Practices and Additional Precautions for Preventing the Transmission of Infection in Health Care*[4]. That document provides a comprehensive list of infectious diseases and the precautions necessary to prevent transmission when caring for patients. Determining compliance with the Routine Practices and Additional Precautions recommended in *Risk Control Measures to Prevent HCW Exposure to or Infection with Disease* (Section A-2.1.3 and Section B-2.1.4) is essential in deciding whether a true exposure has occurred and follow-up is required, as outlined in *Risk Control Measures to Manage HCWs Exposed to or Infected with Disease* (Section B-2.2.).

Recommendations regarding HCWs who are symptomatic, colonized, or infected with a communicable disease, independent of an occupational exposure, are discussed in *Risk Control Measures to Manage HCWs Exposed to or Infected with Disease* (Section B-2.2.). The recommendations for prophylaxis and treatment are current at the time of publication. It may be prudent, however, to confer with the local public health authority on policy, to ensure consistency. Because of the rapid changes in drug regimens, specific recommendations have not been made and the reader is referred to current texts, e.g. *Control of Communicable Diseases Manual*[23] or the *Red Book*[24]. Recommendations for immunizations are those of Canada's National Advisory Committee on Immunization (NACI)[8] unless there is evidence to support an identified alternative.

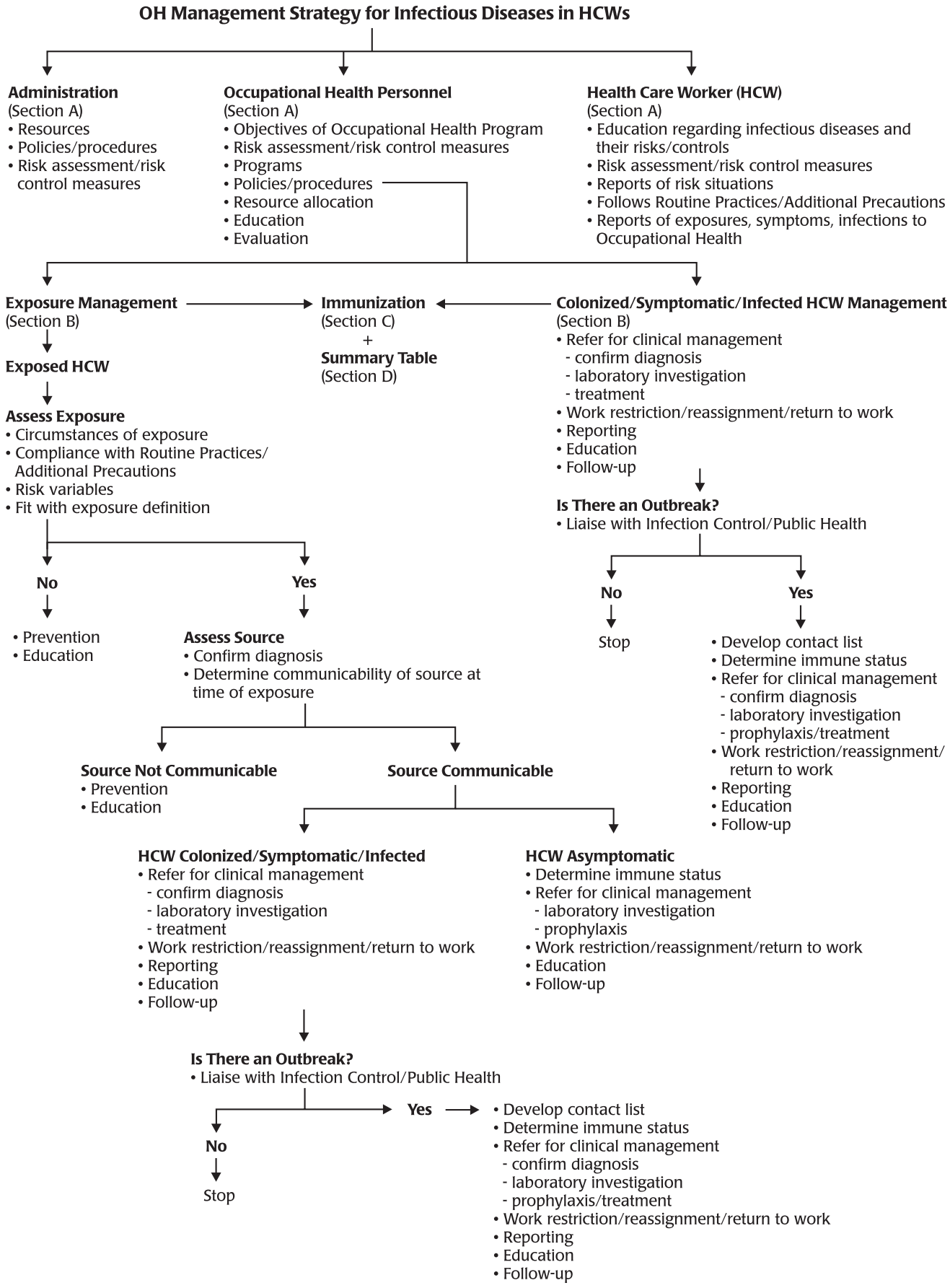
Criteria to Confirm the Diagnosis of the Disease (Section B-2.3) has been included with each disease to help the reader identify a true exposure or infection and to clarify management.

Finally, an algorithm (see Table II on page 6) has been developed to help the reader clarify the roles and responsibilities of OH, the Administration, and the HCW, and to outline the path for management of infection-related issues involving the HCW.

Table I: Occupational Health Management Strategy for Infectious Diseases in HCWs – Template

1.	**Risk Assessment for Transmission of Disease to HCWs**
1.1	Clinical Significance of Disease
1.2	Evidence of Exposure/Transmission of Disease
2.	**Risk Control Measures**
2.1	**Risk Control Measures to Prevent HCW Exposure to or Infection with Disease**
2.1.1	Engineering Controls
2.1.2	Administrative Controls
2.1.3	OH Work Practices
2.1.4	Personal Protective Equipment
2.2	**Risk Control Measures to Manage HCWs Exposed to or Infected with Disease**
2.2.1	Assessment of HCW Exposure to Disease
2.2.1.1	Method of Transmission of Disease
2.2.1.2	Definition of Occupational Exposure to Disease
2.2.2	Assessment of Source of HCW Exposure
2.2.2.1	Communicability of Source
2.2.3	Criteria to Confirm the Diagnosis of Disease
2.2.4	OH Work Practices to Manage HCWs Exposed to or Infected with Disease
2.2.4.1	HCW Exposed to Disease
2.2.4.2	HCW Colonized, Symptomatic, or Infected with Disease
2.2.4.3	OH Management of Disease Outbreak
2.2.4.4	OH Reporting to Public Health Authorities of HCW with Disease
3.	**Education of HCWs about Prevention and Management of Exposure to or Infection with Disease**
4.	**Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infection with Disease**

Table II: Occupational Health Management Strategy for Infectious Diseases in HCWs



Objectives

The infection control objectives of an OH program should be consistent with the general program for IC. They should include the following:

1. *Risk Assessment*: evaluate the workplace to identify hazards related to occupation and to assess and analyze the occupational risk associated with exposure to potentially harmful infectious diseases, taking into consideration events, circumstances, and practices.

2. *Risk Control Measures*: implement appropriate occupational health policies, procedures, and programs to prevent and/or manage exposures or infections in HCWs, including outbreak management.

    - establish mechanisms to ensure appropriate and timely communication with allied professionals.
    - demonstrate fiscal responsibility through policies, procedures, and programs that prevent or reduce occupational infections, absenteeism and disability.

3. *Education:* provide educational programs for HCWs regarding the importance of sound personal hygiene habits and compliance with recommended infection control precautions as an individual's responsibility in the delivery of care and the prevention of transmission of infections.

4. *Evaluation*: implement ongoing, systematic evaluation to ensure that policies, procedures, and programs are consistent with current recommendations, achieve their stated objectives, and are in compliance with current regulations.

– Section A –
Recommendations for Infection Prevention and Control Components of an Occupational Health Program

1. Risk Assessment to Prevent Transmission of Disease to Health Care Workers (HCWs)

The OH program focuses on prevention, health promotion, and the recognition, evaluation, and control or reduction of health hazards in the health care setting. In order to accomplish this, one of the primary activities of OH staff is to perform risk assessments. Critical to such assessments is knowledge of three factors: the potential consequence of the hazard, the likelihood of exposure to the hazard, and the number of persons regularly exposed to the hazard[25]. Infectious disease risk assessment requires adequate knowledge of the following:

- clinical manifestations and significance of the infectious agent,
- epidemiology – characteristics, reservoir, mode of transmission, incubation period, period of communicability,
- transmission factors – type of exposure, size of innoculum, infectivity of organism, susceptibility, control methods.

Workplace surveillance, which is the systematic collection, analysis and dissemination of information on disease, injury, or hazard for the prevention of morbidity or mortality[26], provides much

of the necessary information for risk assessment. Walk-through visits to examine the worksite methodically are an important part of data collection and help the OH nurse to recognize and understand the working conditions of staff, including supplies, equipment, standards of practice, and training. The infection control practitioner and safety officer should participate in these work site visits. The goal should be to visit all areas of the health care setting on at least an annual basis and to visit high-risk sites more frequently. Additional visits should be conducted by OH nurses and physicians to increase their visibility and maintain an ongoing knowledge of the workplace. Workplace surveillance provides valuable information about infectious disease hazards, which can be used to consider the various levels of risk, identify the employee populations to be monitored, establish priorities, and reinforce two-way communication between OH and HCWs[27].

The OH program also provides risk assessment specific to the HCW by way of a health assessment. This involves obtaining an occupational history and personal history of infectious diseases, testing the HCW, interpreting data, monitoring and educating. The preplacement examination of the HCW[27], which is done after hiring and before placement, is an ideal time to begin this process. Various workplaces have different approaches: some complete an entire physical examination[28] with extensive laboratory tests, whereas others find a more targeted approach with a questionnaire and selective laboratory testing to be satisfactory[29] and more cost-effective[30]. Information about conditions that may affect skin integrity, latex allergy, and past immunizations is important to HCW placement. Specific aspects of the preplacement examination are identified throughout this guideline in relation to the particular disease. In addition, ongoing interactions between OH and the HCW, e.g. concerning exposures, infections, or scheduled recall visits, may contribute information to the overall risk assessment process.

Data collected from all sources regarding workplace surveillance, HCW preplacement examinations, and periodic interactions with HCWs enable OH to assess the levels of risk for the various infectious disease hazards in the workplace[27]. With all aspects considered, OH is able to make an estimation of risk that can guide decisions about risk management strategies[25] specific to infectious diseases[31].

Recommendations

It is the responsibility of Administration to provide sufficient resources to Occupational Health programs to achieve the following recommendations.

1.1 OH should recognize risk situations with the potential for occupational exposure or transmission of infectious disease either to or from the HCW and other individuals or the environment. OH is responsible for risk assessment activities, which include but are not limited to the following:

1.1.1 regular workplace surveys/walk-through visits, to become familiar with the workplace, collect information regarding the potential for exposure to infectious disease hazards, and identify work practices[29,32]; **AIII**

1.1.2 preplacement and periodic examination for immune status, achieving immunization requirements, communicating the benefits and side effects of each vaccine to the worker, tuberculin skin testing, recording the history of previous or present infectious diseases, and appropriate serologic testing[8,29,33-36]; **AIII**

1.1.3 review of occupational infectious disease exposure records[29], including needlestick or sharps injuries and actual occupational transmission of infectious diseases in the health care setting[37,38]; **AIII**

1.1.4 review of infectious disease literature, including journals, for evidence regarding exposure, transmission, prevention and control[19,29] including journals; **AIII**

1.1.5 establishing and maintaining communication with appropriate personnel, departments and/or agencies in order to meet OH objectives[28,29,35]; **AIII**

1.1.6 working in collaboration with IC to assess actual worker risk from infected or colonized patients[35,39,40]. **AIII**

1.2 OH should collect information and evaluate various occupational risks according to the potential consequence of exposure and transmission of the infectious disease, the likelihood of exposure to the infectious agent, and the number of persons exposed regularly to the hazard[25,36,41]. Hospital librarians may assist with searches on Internet and Medline[42] to provide the latest evidence. **AIII**

1.3 OH should establish specific objectives to prevent and manage differing occupational risks[29] for infectious diseases on an ongoing basis[28]. **AIII**

1.4 In collaboration with IC, OH should recommend to the Administration all appropriate action(s) to meet the program's objectives, which may include[29,35] but are not limited to

1.4.1 developing new or revised control measures (see 2. below),

1.4.2 providing education (see 3. below),

1.4.3 developing, reviewing, or revising quality assurance methods for evaluation (see 4. below). **AIII**

1.5 OH should act as an advocate for safe, healthy workplaces by raising the Administration's awareness of its responsibility to minimize the risk[28] of infectious disease exposure or transmission in the workplace[29,31,43]. **AIII**

1.6 OH should use quality assurance principles to ensure effectiveness in identifying risks[28,29]. **AIII**

2. Risk Control Measures

2.1 Risk Control Measures to Prevent HCW Exposure to or Infection with Disease

The risk control measures described in this guideline use the industrial hygiene hierarchy[31,41,44] of

1) **Engineering Controls**,
2) **Administrative Controls**,
3) **OH Work Practices, and**
4) **Personal Protective Equipment**.

The control measures are listed in descending order according to their effectiveness in reducing the risk of exposure to infectious diseases. For example, Engineering Controls decrease or eliminate the hazard, whereas the use of Personal Protective Equipment only provides a barrier between the HCW and the hazard. Similarly, an Engineering Control would be more effective because the HCW is not responsible for decision-making regarding the intervention at the time of interaction with the patient, when it may be difficult to switch to an alternative action such as use of Personal Protective Equipment[31,44]. Administrative Controls[44] provide the overall policies and procedures that establish a framework for good operations[45,46]. OH Work Practices describe the role of OH in helping to implement policies designed to protect the worker from exposure to and infection with disease.

2.1.1 *Engineering Controls*

Engineering Controls decrease HCWs' exposure to the hazard by reducing the hazard at the source[28,44], e.g. negative ventilation pressure with exhaust to the outside in a room for a person with tuberculosis[17], design modifications for sharp instruments making them safer and less likely to pierce the skin of HCWs, potentially exposing them to bloodborne pathogens[47-52].

Recommendations

It is the responsibility of Administration to provide sufficient resources to Occupational Health programs to achieve the following recommendations.

2.1.1.1 Administration and OH, in collaboration with IC and Engineering/Physical Plant, should ensure that there is effective equipment, preferably proven to reduce HCW exposure and improve safety during intended use as well as during HCW handling, maintenance, or cleaning:

a) adequate number of appropriately maintained negative pressure rooms located in areas of the health care setting where patients requiring Airborne Precautions are most likely to be placed[4,17]; **AIII**

b) adequate number of optimally placed handwashing sinks and dispensers for soap and/or waterless antiseptic hand rinses and single-use hand towels to optimize hand hygiene[10]; **AIII**

c) knee or foot controlled sinks or sinks with an automatic eye, rather than sinks with hand controls, to prevent cross-contamination[10]; **BIII**

d) adequate number of appropriately maintained accessible eye wash stations for use in areas where eye splashes are most likely to occur[10,11]; **AIII**

e) adequate number of optimally placed and appropriate, puncture-proof sharps disposal and other biohazard containers[11,53]; **AIII**

f) convenient and safe equipment for cleaning and sanitizing patient care articles, e.g. bedpans, urinals, and measuring containers, to prevent HCW exposure to potentially infectious body fluids[10]; **AIII**

g) adequate number of appropriately maintained refrigerators to ensure separate and safe storage of food, medications, vaccines, and laboratory specimens[54]; **AIII**

h) adequate equipment for HCWs during patient procedures[10], e.g. retractable needles[11], blunt needles[55], needleless intravenous systems[56], sharps containers[53], masks, facial goggles, splash shields[11], and gloves[11]; **AIII**

i) heating, ventilation and air conditioning (HVAC) systems with suitable design options and recommendations for control and monitoring[57] (the construction of health care facilities should be planned so as to enhance the ability for maintenance and cleaning of these systems); **AIII**

j) waste management systems with appropriate design and function[10,58-60]. **AIII**

2.1.1.2 Administration, in collaboration with IC, Engineering/Physical Plant, Environmental Services and Materiels Management, should ensure that processes are in place for

a) appropriate cleaning and maintenance of heating, ventilation and air conditioning (HVAC) systems[57]; **AIII**

b) a safe, potable water supply and alternatives during disruptions as per provincial/territorial regulations;

c) compliance with discipline-specific safety standards with respect to the use of equipment that enhances safety, e.g. sharps containers[53], biosafety

cabinets[11,18], heating, ventilation and air conditioning systems[57], and refrigeration as per provincial/territorial regulations; **AIII**

d) appropriate cleaning and disinfection of patient care equipment and environment, e.g. Housekeeping[10]; **AIII**

e) appropriate cleaning, disinfection and sterilization of patient care equipment e.g. Central Supply Department[10,61-65,66]. **AIII**

2.1.2 *Administrative Controls*

Administrative Controls include the development and adoption of policies and procedures that support Engineering Controls[29,45], e.g. negative pressure rooms to accommodate suspected or confirmed respiratory TB cases[17,41,44], the use of Work Practices, e.g. immunization of HCWs[8,28,29,41], and Personal Protective Equipment for HCWs[28,29,41,44], e.g. gloves if exposure to body fluids is anticipated[11].

Recommendations

It is the responsibility of Administration to provide sufficient resources to Occupational Health programs to achieve the following recommendations.

2.1.2.1 Administration should ensure there is an effective OH program with clearly defined objectives[28,29,31,54]. **AIII**

2.1.2.2 Administration should provide the necessary financial and human resources to meet the OH program objectives and, whenever possible, evaluate the following:

a) adequate OH professional and clerical staffing[28,29,47,54,66] with backup for shortfalls caused by illness or vacation[54]; **AIII**

b) access to expert consultative services when required[29]; **AIII**

c) adequate support staffing, e.g. housekeeping, to comply with OH and IC policies and procedures[67]; **AIII**

d) adequate funding for OH to update its professional[29] and initial or ongoing computer-based knowledge[68,69]; **AIII**

e) access to reference material that includes, but is not limited to, Internet-based resources and publications, as listed on page iv of this guideline, as well as the following publications:

- American Academy of Pediatrics. *2000 Red Book: Report of the Committee on Infectious Diseases,* 25th ed., 2000[24]
- Chin J. ed. *Control of Communicable Diseases Manual,* 17th ed., 2000[23];

AIII

f) access to a computer hardware and software system with Internet access and other software programs for information gathering[70] in order to implement effective educational programs, learn about infections in HCWs, refer to health acts and regulations[68], assist with data collection and analysis of HCW surveillance[69], and learn about new technological developments[71]. **AIII**

2.1.2.3 Administration and OH should ensure that the OH program has relevant policies and procedures[46], which adhere to legislative requirements and published guidelines and literature[68]; these may include but are not limited to

a) confidentiality and maintenance of HCW medical records through the use of a secure record keeping system as required by legislation[29,34,72-74]; **AIII**

b) surveillance of HCW exposures[29,36,75] or potential exposures (such as needlestick injuries) to infection, including data collection, analysis, and communication of results[76,77]; **AIII**

c) preplacement and periodic HCW screening regarding

- vaccine preventable diseases for all HCWs according to recognized guidelines and published literature[7-9,12,19,36,78,79],
- provision of appropriate vaccines unless contraindicated[7-9,12,19,79],
- documentation of and reasons for refusal of vaccine, if this occurs[80],
- tuberculosis testing according to recognized guidelines and published literature[17],
- storage of data that include the immunization status of HCWs in a secure database where it is readily accessible, especially in an outbreak situation[33]. Information in a centralized health information system on a central computerized database can be designed for various levels of access by users from their worksite. Multiple levels of passwords and locking of files permit only authorized access[69] — that is, access in an outbreak situation could be obtained by previously authorized personnel to obtain the employee's immunization status from a specific file, which is separate from the employee file with personal health information,
- appropriate placement of a HCW[28,29,31], including considerations for the immunocompromised HCW's fitness for work prior to placement; **AIII**

d) management of HCWs with specific health conditions that carry an increased risk for exposure[29] to infections[34,35], e.g. dermatitis[45,81], and those who are immunocompromised[11,31]; **AIII**

e) identification of objectives to reduce needlestick injuries, including the establishment of a multidisciplinary committee[38,47-49]; **BIII**

f) purchase and testing of safer equipment to be used by the HCW, e.g. passive retractible needles (also see Engineering Controls page 12)[38]; **AIII**

g) the opportunity for the HCW to choose and use the most appropriate personal protective equipment, e.g. masks, gloves, face goggles, splash shields; **AIII**

h) safer work practices by the HCW[44], e.g. infection control precautions[4,10,11], handling of sharps[41,45,50,51,82-84]; **AIII**

i) management of the HCW exposed[28,29] to, colonized, or infected with microorganisms, to include[33-35]

- ensuring that there is a referral process, either internal or external, for confirmation of diagnosis and clinical management, for example
  – laboratory investigation
  – prophylaxis
  – treatment
  – counselling
  – follow-up
- ensuring that there is a process for postexposure management, for example
  – referral for clinical management
  – work restrictions/reassignment/return to work
  – outbreak management
  – reporting to public health authorities
- ensuring that there is a provincial/territorial workers compensation group process for occupational exposure and/or infection; **AIII**

j) outbreak management for exposures and/or symptomatic or colonized infectious diseases of HCWs[33,85]; **AIII**

k) communication with appropriate personnel and/or agencies[27-29,31,49]:

- administration
- educational services
- emergency responders
- environmental services
- infection control
- laboratories

- engineering/physical plant
- product evaluation
- public health authorities
- purchasing/materiels management
- quality assurance
- safety
- employee relations
- workers' compensation agency **AIII**

l) continuing education of HCWs[34] and OH staff to maintain professional competence[28,29,31], and initial and ongoing computer skills[68]; **AIII**

2.1.2.4 Administration, in collaboration with IC, Engineering/Physical Plant, Environmental Services and Materiels Management should ensure that the OH program has supporting systems in place to prevent or minimize occupational exposure through compliance with policies and procedures, safety standards, and regulations, including the provincial/territorial workers' compensation agency. Supporting systems include but are not limited to

a) adequate housekeeping and waste management services to maintain a safe work environment[10,43]; **AIII**

b) appropriate processes for cleaning, decontamination, disinfection, and sterilization of patient care equipment[10,61-63,65,86]; **AIII**

c) process for purchasing equipment and supplies that, if possible, are proven to have a safer design in preventing HCW exposure during handling, maintenance, or cleaning, e.g. passive needlestick devices[48], hands free sinks[10], sharps containers[50,87], blunt needles[55], and needleless intravenous systems[88-90]; **AIII**

d) process for purchasing the most appropriate Personal Protective Equipment as recommended to prevent HCW exposure to infectious disease[4,11,54]. **AIII**

2.1.2.5 Administration should ensure that external service providers comply with the workplace OH program and that this is outlined in contractual agreements. **BIII**

2.1.2.6 Administration should ensure that the OH program has access to appropriate medical and laboratory resources for timely diagnosis, laboratory investigation, prophylaxis, treatment, and follow-up as required[85]. **AIII**

2.1.2.7 Administration should support the educational component of the OH program by providing[28,29,31]

a) HCW education[34,35,91-93], **AIII**

b) OH staff education to (1) maintain professional competencies through opportunities such as continuing education courses, journal subscriptions, and conferences[68]; and (2) provide learning opportunities about both computer hardware and software to assist with the collection and analysis of data, handouts or visual presentation material for educational programs, and information on health acts and regulations[68] from provincial/territorial governments. **AIII**

2.1.2.8 Administration and OH should ensure compliance with OH policies and procedures, safety standards, provincial/territorial workers' compensation regulations, Workplace Hazardous Materials Information System[94], and other OH legislation. **AIII**

2.1.2.9 Administration should ensure adequate supervision of all HCWs to ensure compliance with IC policies, procedures, and practices[28,85]. **AIII**

2.1.3 *OH Work Practices*

OH Work Practices include those actions intended to decrease the risk[44] of HCWs' exposure to and infection with disease[28,29,31,41].

Recommendations

It is the responsibility of Administration to provide sufficient resources to Occupational Health programs to achieve the following recommendations.

2.1.3.1 OH should identify and assess the risk of employee exposure[28] to infectious diseases[29,31,85]. **AIII**

2.1.3.2 OH should develop OH program objectives[28,29,31]. **AIII**

2.1.3.3 OH should identify and secure financial and human resources to meet the stated objectives[28,29,31,54]. **AIII**

2.1.3.4 OH should develop policies and procedures to direct the OH program objectives [28,29,31] and keep them updated[46]. **AIII**

2.1.3.5 OH should advise HCWs to practice good infection control as recommended in Health Canada's *Routine Practices and Additional Precautions for Preventing the Transmission of Infection in Health Care*[4]. **AIII**

2.1.3.6 OH should implement programs and procedures to decrease the risk of exposure to or colonization/infection with infectious diseases. These procedures include but are not limited to the following:

a) assessing the workplace regularly with IC for hazardous situations that allow for exposure to and/or transmission of infection[28,29,31], **AIII**

b) conducting surveillance, involving data collection, analysis, and communication of results[28,29,31], including blood and body fluid exposures[27,47,76,77], **AIII**

c) conducting preplacement[31] and periodic screening[28,29] for vaccine preventable diseases[8] for all HCWs, **AIII**

d) providing appropriate vaccines as outlined in Section C, and enhancing their acceptance and availability to health care workers[46], unless contraindicated[7-9,12,19], **AIII**

e) ensuring appropriate handling and delivery of immunizations, immunoglobulins, and medications[8,79], **AIII**

f) documenting immunization administration[8,29] or refusal of vaccine according to standards of practice, **AIII**

g) managing HCWs with dermatitis[45,81,95] and those who are immunocompromised, **AIII**

h) managing HCWs exposed to[12,19,96-99] or infected with microorganisms, to include[85]

- ensuring that there is a referral process, either internal or external, for confirmation of diagnosis and clinical management, which may cover
  – laboratory investigation
  – prophylaxis
  – treatment
  – counseling
  – follow-up
- ensuring that there is a system for postexposure management, which may include
  – referral for clinical management
  – work restrictions/reassignment/return to work
  – outbreak management
  – reporting to public health authorities
- ensuring that the provincial/territorial workers' compensation group process is followed for occupational exposures and/or infections **AIII**

i) ensuring OH participation in the workplace HCW outbreak management plan[33,85], **AIII**

j) ensuring appropriate handling and disposal of sharps by HCWs[11,47-52], **AIII**

k) identifying, piloting and using equipment that has been designed and proven, if possible, to reduce exposure and improve safety as listed in Engineering Controls, page 12, e.g. passive retractable needles on syringes[38,47,48]. **AIII**

2.1.3.7 In order to meet OH program objectives[28,29,31], OH should establish and maintain communication with appropriate personnel, departments and agencies:

- administration
- educational services
- emergency responders
- environmental services
- infection control
- laboratories
- engineering/physical plant
- product evaluation
- public health authorities
- purchasing/materiels management
- quality assurance
- safety
- employee relations
- workers' compensation agency

AIII

2.1.3.8 OH should provide expertise to the joint Occupational Health and Safety Committee[31], Infection Prevention and Control Committee, or other related committees and administration[28,29]. **AIII**

2.1.3.9 OH should report work infection risk assessment reviews[29] to the joint Occupational Health and Safety Committee[28,31], Infection Prevention and Control Committee, and Administration[34]. **AIII**

2.1.3.10 OH must maintain confidentiality of HCW medical records as per legislation.

2.1.4 *Personal Protective Equipment*

Personal Protective Equipment includes clothing, gloves, masks, face goggles, and splash shields, which can be used by a HCW to provide a barrier[44] against potentially infectious microorganisms[11,28,29]. Although appropriate Personal Protective Equipment

reduces the risk of exposure to an infectious agent, it may not be 100% effective[100]. For example, compared with no glove, glove material decreased the volume of blood transferred by hollow-bore needles in an in vitro (paper/tissue) model by a mean of 46% and in an ex vivo (animal tissue) model by 63%. The mean blood volume transferred from suture needles in both models was reduced by 86% when a single sterile latex glove was used as compared with no glove[100]. There was a trend toward increased protection with additional layers[100]. However, as the needle can penetrate materials such as those used to make gloves, gloves do not provide absolute protection.

Recommendations

It is the responsibility of Administration to provide sufficient resources to Occupational Health programs to achieve the following recommendations.

2.1.4.1 OH should, in collaboration with IC and others, monitor, identify, pilot, evaluate, and suggest products for Personal Protective Equipment as recommended in Health Canada's *Routine Practices and Additional Precautions for Preventing the Transmission of Infection in Health Care*[4,11,17,101]. **AIII**

2.1.4.2 Administration should provide Personal Protective Equipment[29,31,44] that has been proven, if possible, to have a safer design in preventing exposure to infectious diseases[4,11,17,28] . **AIII**

2.1.4.3 Administration should provide gloves that are appropriate for a variety of tasks and that may include non-powdered, low protein latex medical gloves[4,11,102], or vinyl or alternative synthetics, e.g. nitrile, for managing HCWs with latex allergy. **AIII**

2.2 Risk Control Measures to Manage HCWs Exposed to or Infected with Disease

Recommendations

It is the responsibility of Administration to provide sufficient resources to Occupational Health programs to achieve the following recommendations.

2.2.1 *Assessment of HCW Exposure to or Infection with Disease*

2.2.1.1 OH should assess each incident with the disease-specific exposure definition to determine whether the circumstances constitute an exposure[11,12,19,23], using other factors that include but are not limited to

- the method of transmission,
- type of exposure,
- use of Personal Protective Equipment[4,11],
- compliance with Routine Practices and Additional Precautions[4],

- infectivity of source and
- immunity of exposed person. **AIII**

2.2.2 *Assessment of Source of Health Care Worker Exposure*

2.2.2.1 OH should, in collaboration with IC, confirm the diagnosis and communicability of the source using other factors to confirm the diagnosis, including[23,24,33] but not limited to

- incubation period,
- period of communicability,
- laboratory results and
- liaison with medical staff and or public health authorities. **AIII**

2.2.3 *Criteria to Confirm the Diagnosis of the Disease*

2.2.3.1 OH, in collaboration with IC, should confirm that the source of the HCW exposure had an infection compatible with the criteria for diagnosis[33-35]. **AIII**

2.2.3.2 OH should assess the clinical presentation of the symptomatic HCW against the disease-specific criteria for diagnosis[33]. **AIII**

2.2.4 *OH Work Practices to Manage HCWs Exposed to or Infected with Disease*

OH should implement the procedures for the management of HCWs exposed to or colonized/symptomatic/infected with infectious diseases according to the disease-specific definition of occupational exposure and/or criteria to confirm the diagnosis given in Parts B and D of this manual. Such procedures may be performed by OH or arranged through an external referral. Outbreak management should always be a consultative process with IC[33] and public health authorities. OH work practices may include[8,9,12,28,29] but are not limited to

a) determining immune status of HCW,

b) managing exposure/infection, including:

- laboratory investigations,
- prophylaxis,
- treatment,
- counseling,
- follow-up,
- work restrictions/reassignment/return to work,

c) performing contact tracing among HCWs,

d) managing outbreak situations when staff are involved as contacts or as potential sources of outbreaks,

e) assessing fitness for work,

f) liaising with IC,

g) liaising with public health authorities,

h) liaising with emergency responders,

i) reporting to public health authorities according to established mechanisms, which may in some jurisdictions be through IC,

j) possible contact tracing and prophylaxis of close contacts in the case of infectious diseases that require statutory reporting. **AIII**

3. Education of HCWs about Prevention and Management of Exposure to and Infection with Disease

Education of HCWs is an essential component of an OH program[54]. Education about infectious disease hazards is required to increase understanding and to encourage prompt reporting, evaluation, and treatment[30,34,35,85,103] of injuries and timely notification to the provincial/territorial workers' compensation agency. Reports indicate that education may positively influence behavioural activities, including increasing the uptake of vaccines[91,92,104].

Important topics to address include the use of Routine Practices in infection control, which incorporate practices formerly known as bloodborne pathogen precautions or universal precautions and includes hand hygiene[4,10]. Additional Precautions to prevent and control airborne, contact, and droplet transmission are equally important[4].

OH staff need to be creative with focused education to meet the needs of different learner groups[28,29,31,34,35,76,93,105]. Education programs include hands-on training to familiarize HCWs with new equipment and give them time to feel comfortable with it, e.g. needlestick-prevention devices[106] and masks. Videos[107] and group discussions[108] add to the presentation and appeal to a broader range of employees.

A Canadian study conducted in 1996 reported that less than 50% of survey respondents were confident of their knowledge of protective precautions and bloodborne diseases, and 20% did not know what to do if they had a sharps injury[109]. There is evidence that employees who perceive a risk of transmission from exposure to bloodborne pathogens are more likely to protect themselves[108,110]. Educational efforts need to be ongoing[11].

Educational programs should be planned in collaboration with IC and Education Services. They should be innovative and comprehensive, should explain the consequences of non-compliance clearly, and should offer the latest exposure and infection evidence to support the practice[11]. OH should consider the various stages involved in behavioural change when designing educational

programs to help employees protect themselves by following recommended work practices and using personal protective equipment[92,93,110].

Recommendations

It is the responsibility of Administration to provide sufficient resources to Occupational Health programs to achieve the following recommendations.

3.1 OH, in collaboration with IC and Educational Services, should provide orientation and ongoing education as well as hands-on training, if required, to HCWs to prevent and control infectious disease exposure and transmission of infection. Such education will include but is not limited to

3.1.1 the role of OH and the importance of liaison with IC[22] and public health authorities; **AIII**

3.1.2 immunizations recommended for HCWs[8,34,79,103]; **AIII**

3.1.3 disease epidemiology[23]:

- methods of transmission,
- incubation period,
- period of communicability,
- risk of transmission, and
- signs/symptoms of infection; **AIII**

3.1.4 exposure prevention:

- exposure definitions as noted in Section B: Individual or Grouped Diseases,
- importance of Routine Practices, including good hand hygiene, Additional Precautions (airborne, droplet and contact)[4] and compliance with the use of Personal Protective Equipment[4,11],
- importance of good personal hygiene,
- importance of complying with safe work practices[28,29,31,51], including garbage disposal[10,11,53,58,76,111],
- importance of not eating, drinking, applying cosmetics or smoking in areas where patient care takes place, in a laboratory setting[28,31,76,112,113], or where contaminated equipment is processed; **AIII**

3.1.5 postexposure follow-up[23,85]:

- first aid procedures[11,12,19],
- screening[12,17,19],
- prophylaxis and treatment[8,12,19,29],
- referral for clinical management,

- work restrictions/reassignment/return to work[28,29,31,76],
- contact tracing,
- outbreak control measures; **AIII**

3.1.6 communication and legislative reporting:

3.1.6.1 communication to OH by HCWs:

- occurrence of infectious disease exposures and infections that may be transmitted in the workplace[28],
- initial occurrence and recurrence of symptoms in self [85] or occurrence of related symptoms in household members,
- when advised previously by OH to return for assessment for fitness to work[29]. **AIII**

3.1.6.2 OH or IC reporting to public health authorities:

- case and suspected or confirmed outbreak reporting as required by the provincial/territorial *Public Health Act*,
- possible inclusion of emergency responders for rapid notification for contact tracing, as in *A National Consensus on Guidelines for Establishment of a Post-Exposure Notification Protocol for Emergency Responders*[19,96-99,114],

3.1.6.3 OH reporting to the provincial/territorial workers' compensation group[29]:

- information required about occupational exposures[28] or infections. **AIII**

4. Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infection with Disease

"Effective surveillance systems for monitoring existing practices and methods for gathering information about occupational risk are essential for achieving a safer healthcare workplace[115]." The use of the risk assessment process, risk control measures, and education should increase the ability of OH staff to reduce exposures of HCWs, provide appropriate treatment and follow-up of infections to prevent transmission, and establish priorities for resource allocation. Evaluation processes to monitor/measure outcomes in all components are necessary to ensure the efficacy and cost-effectiveness of the OH program[28-31,76,116].

Recommendations

It is the responsibility of Administration to provide sufficient resources to Occupational Health programs to achieve the following recommendations.

4.1 OH should evaluate the efficacy and cost-effectiveness of the individual components of the OH program. This can be achieved through analysis of outcome indicators[108,116,117]. Indicators should include but are not limited to the following:

- 4.1.1 numbers or rates of occupational versus community exposures or infections,
- 4.1.2. rates of occupational exposures and infections, e.g. hepatitis B, hepatitis C, or HIV and TB,
- 4.1.3 immunizations given to decrease infection rates and vaccine refusal rates,
- 4.1.4 time lost due to exposures and infections,
- 4.1.5 workplace exposure/infection hazards,
- 4.1.6 equipment failures that result in or have a potential to result in exposures,
- 4.1.7 HCW participation in educational sessions/programs that, e.g. increase HCWs' knowledge of the benefits of hepatitis B vaccine, their use of safer needlestick devices, their selection of appropriate personal protective equipment, and adherence to Work Practices,
- 4.1.8 staff surveys of infection knowledge, prevention and control knowledge, and practice, e.g. hand hygiene surveys,
- 4.1.9 referral services,
- 4.1.10 liaison with public health authorities,
- 4.1.11 cases of vaccine preventable diseases and cost to health care[79],
- 4.1.12 trends in incidence/prevalence rates,
- 4.1.13 data for decreased worker compensation claims due to infectious diseases[108].

AIII

4.2 OH should liaise with IC to conduct assessments of HCW compliance with Health Canada's *Routine Practices and Additional Precautions for Preventing the Transmission of Infection in Health Care*[4]. **BIII**

– Section B –
Recommendations for Diseases of Significance to Occupational Health

– Part I –
Individual Diseases

Adenovirus – Epidemic Keratoconjunctivitis (EKC)

The following information pertains *only* to adenovirus strains that cause epidemic keratoconjunctivitis (EKC); see page 152 for information about adenoviruses causing respiratory infections.

1. Risk Assessment for Transmission of EKC to HCWs

1.1 Clinical Significance of EKC

EKC is a severe and painful conjunctivitis that may continue for several weeks and is followed by a phase of corneal infiltration, often impairing vision for months[118].

1.2 Evidence of Exposure/Transmission of EKC

Since World War II, nosocomial epidemics have been reported and attributed to eye-hand-eye contact, i.e. contact of the HCW's unwashed hands with the patient's eye, inadequately disinfected ocular instruments, and contaminated ophthalmic solutions[118].

Outbreaks involving transmission through hand-eye contact have been frequently reported[118-122].

Jernigan et al reported on an outbreak involving 126 (7%) of 1,870 patients and 4 ophthalmologists and concluded that transmission was due to inadequate disinfection of instruments, especially pneumotonometers, and finger-to-eye transmission by HCWs. Ophthalmologists with EKC were a significant risk factor for patients acquiring infection[118].

One ophthalmology clinic reported that 15 HCWs acquired EKC during an outbreak (10 ophthalmologists, 3 nurses, and 2 support staff). Five of the 15 experienced secondary spread to their household contacts[119].

Recommendations

Compliance with the recommendations for the components of an OH program outlined in Section A–1-4 is required in addition to the following specific recommendations for adenovirus causing EKC.

2. Risk Control Measures

2.1 Risk Control Measures to Prevent HCW Exposure to or Infection with EKC

2.1.1 *Engineering Controls*

OH should liaise with IC and Engineering/Physical Plant to ensure optimal placement of appropriately maintained eyewash stations in areas where patients with EKC are likely to be. **AIII**

2.1.2 *Administrative Controls*

See Section A-2.1.2.

2.1.3 *OH Work Practices*

See Section A-2.1.3.

2.1.4 *Personal Protective Equipment*

OH should advise HCWs to wear gloves when entering the single room or designated bedspace in a shared room of a pediatric patient for whom Contact Precautions are in place for suspected or confirmed EKC, and to wear a gown if direct contact with the patient or environmental surfaces is likely[4]. **BII**

2.2 Risk Control Measures to Manage HCWs Exposed to or Infected with EKC

OH should instruct HCW to flush/irrigate eye(s) with water as soon as possible as a first aid measure if eye contamination occurs. **AIII**

2.2.1 *Assessment of HCW Exposure to EKC*

2.2.1.1 Method of Transmission of EKC

EKC is transmitted by direct contact of ocular mucous membranes with infectious eye secretions via contaminated hands or indirectly through contaminated equipment or solutions.

2.2.1.2 Definition of Occupational Exposure to EKC

OH should define exposure as direct or indirect contact of ocular mucous membranes with infectious eye secretions. **AIII**

2.2.2 *Assessment of Source of HCW Exposure*

In collaboration with IC, OH should confirm the diagnosis of the source and assess the potential for communicability at the time of HCW exposure. **AIII**

2.2.2.1 Communicability of Source

The incubation period of EKC is 5 to 12 days, although the duration may be exceeded in many instances. The period of communicability continues

from late in the incubation period to as long as 14 days after onset; prolonged viral shedding has been reported[23].

2.2.3 *Criteria to Confirm the Diagnosis of EKC*

Clinical illness – conjunctivitis

Plus laboratory evidence – viral culture of eye positive for adenovirus

Or – compatible clinical illness in a HCW who is epidemiologically linked to a confirmed case

2.2.4 *OH Work Practices to Manage HCWs Exposed to or Infected with EKC*

2.2.4.1 HCWs Exposed to EKC

There are no modifications of work practices or work restrictions for HCWs exposed to EKC.

2.2.4.2 HCWs Symptomatic or Infected with EKC

OH should refer HCWs symptomatic or infected with EKC for confirmation of diagnosis and clinical management, which may include laboratory investigation. **AIII**

OH should exclude HCWs infected with EKC from direct patient contact until 14 days after the onset of clinical infection in the second eye (if second eye infected), as this represents the period of greatest communicability[118,119,123]. **AII**

OH should refer HCWs infected with EKC for clinical assessment prior to return to work. **AIII**

OH should inform IC of a suspected or confirmed case as soon as possible. **AIII**

2.2.4.3 OH Management of EKC Outbreak

OH should consider the possibility of an outbreak if more than one HCW on the same unit meet the criteria for diagnosis. **AIII**

OH should liaise with IC and public health authorities if an outbreak is suspected. **AIII**

OH may, in consultation with IC, modify work restrictions as necessary in outbreaks. **BIII**

2.2.4.4 OH Reporting to Public Health Authorities of HCWs with EKC

There is no reporting requirement for a single case; OH should report a suspected or confirmed outbreak to public health authorities as required by legislation.

3. Education of HCWs about Prevention and Management of Exposure to or Infection with EKC

OH should design education specific to EKC according to the recommendations outlined in Section A-3, to include

- appropriate handling, i.e. cleaning, disinfecting and sterilization of equipment,
- informing OH if conjunctivitis occurs[67],
- risk of contamination of contact lenses and eye make-up,
- instructing HCW to irrigate eye(s) as soon as possible in the event of an exposure. **AIII**

4. Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infection with EKC

OH should refer to Section A-4 to develop an evaluation program specific to EKC, to include

- number of exposures,
- number of exposures leading to transmission,
- time lost due to infections. **AIII**

Creutzfeldt-Jakob Disease (CJD)

Administration should ensure that OH develops policies and procedures for the prevention and management of HCW exposure and/or infection with CJD according to Health Canada's *Creutzfeldt-Jakob Disease (CJD) in Canada*[2] and related provincial/territorial recommendations.

Cytomegalovirus (CMV)

1. Risk Assessment for Transmission of CMV to HCWs

1.1 Clinical Significance of CMV

The most severe form of CMV, with signs and symptoms of severe generalized infection especially involving the central nervous system and liver, develops in 5% to 10% of infants infected in utero. The remainder of intrauterine infections are inapparent. CMV infection acquired later in life is generally unrecognized in healthy adults but may cause a syndrome clinically similar to Epstein-Barr virus mononucleosis. CMV is the most common cause of post-transfusion mononucleosis-like illness as a result of transfusion to nonimmune individuals[23].

Relapsing CMV disease occurs in immunodeficient and immunosuppressed patients, causing pneumonia, retinitis, hepatitis, and gastrointestinal tract disorders. CMV is a common factor in post-transplant infection, causing disease in both solid organ and bone marrow transplant patients[23].

Following primary infection, viremia usually continues for a few days or weeks. Prolonged viral excretion in saliva and urine may persist for weeks or months after infection[124] and recurs throughout life.

1.2 Evidence of Exposure/Transmission of CMV

CMV transmission between patients proven by analysis of viral DNA[125,126] has occurred, but should be preventable with appropriate hygiene and handwashing[124,127-129].

Transmission of CMV to HCWs occurs rarely, if at all. It has never been documented[124,130] or even inferred from seroconversion rates of nursery nurses[131-133].

A large prospective seroepidemiologic study of HCWs determined that primary acquisition of CMV was not an occupational risk for renal transplant and neonatal intensive care nurses[134].

In a review of hospital transmission of CMV, Adler[124] noted that pregnant HCWs do not need to be tested for CMV immunity before or during pregnancy for several reasons: the low incidence of infection, the difficulty in establishing a diagnosis of primary infection during pregnancy, and the extreme uncertainties involved in counselling a woman who acquires

CMV during pregnancy. The authors also stated that pregnant HCWs should not be excluded from working with CMV positive patients, as CMV transmission can be prevented by adhering to appropriate infection control practices.

Recommendations

Compliance with the recommendations for the components of an OH program outlined in Section A–1-4 is required in addition to the following specific recommendations for CMV.

2. Risk Control Measures

2.1 Risk Control Measures to Prevent HCW Exposure to or Infection with CMV

2.1.1 *Engineering Controls*

See Section A-2.1.1.

2.1.2 *Administrative Controls*

See Section A-2.1.2.

2.1.3 *OH Work Practices*

OH should not reassign/exclude HCWs who are pregnant or planning a pregnancy from working with CMV infected patients[124,125,131,133-140]. **AII**

OH should not screen HCWs who are pregnant or planning a pregnancy for immunity to CMV. The accuracy of the tests used for diagnosis of in utero CMV infections is undetermined; screening is of limited value and is not recommended[24,30,124,128,129,140]. **AII**

OH should provide education to pregnant HCWs on the potential risk of acquisition for susceptible pregnant women and the importance of good hand hygiene during delivery of care to all patients[24]. **AIII**

2.1.4 *Personal Protective Equipment*

See Section A-2.1.4.

2.2 Risk Control Measures to Manage HCWs Exposed to or Infected with CMV

2.2.1 *Assessment of HCW Exposure to CMV*

2.2.1.1 Method of Transmission of CMV

CMV is transmitted by direct contact of mucous membranes with infectious excretions and secretions, especially saliva and urine, or with infected blood/tissues/organs.

2.2.1.2 Definition of Occupational Exposure to CMV

OH should define exposure as direct contact of mucous membranes with infectious saliva, genital secretions, or urine. **AIII**

2.2.2 *Assessment of Source of HCW Exposure*

In collaboration with IC, OH should confirm the diagnosis of the source and assess the potential for communicability at the time of HCW exposure. **AIII**

2.2.2.1 Communicability of Source

The incubation period is variable. Illness following a transplant or transfusion with infected blood begins within 3 to 8 weeks. Infection acquired during birth is first demonstrable 3 to 12 weeks after delivery[23]. The period of communicability, i.e. virus excreted in urine and saliva after primary infection, may persist or be episodic for several years. The virus may be excreted for 5 to 6 years after neonatal infection. It persists as a latent infection in adults; intermittent excretion recurs with immunodeficiency and immunosuppression[23].

2.2.3 *Criteria to Confirm the Diagnosis of CMV*

Clinical illness –
primary: mononucleosis-like syndrome with fever, lymphadenopathy, hepatosplenomegaly

relapse: most commonly pneumonitis, retinitis, gastrointestinal (GI) tract disorders, or hepatitis

congenital: usually asymptomatic but may include jaundice, purpura, hepatosplenomegaly, retinitis, microcephaly, developmental delay, or deafness

Plus laboratory evidence –
primary: viral culture of an appropriate clinical specimen positive for CMV: IgM positive; IgG positive; CMV antigenemia positive; CMV-RNA positive or CMV-DNA strongly positive (available in some reference laboratories) in a previously seronegative individual

relapse: viral culture of an appropriate clinical specimen positive for CMV: CMV antigenemia positive; CMV-RNA positive or CMV-DNA strongly positive (available in some reference laboratories) in a previously seropositive immunocompromised individual with an appropriate clinical picture

congenital: viral culture of an appropriate clinical specimen positive for CMV: CMV antigenemia positive; polymerase chain reaction (PCR) of an appropriate clinical specimen strongly positive within the first week of life

2.2.4 *OH Work Practices to Manage HCWs Exposed to or Infected with CMV*

2.2.4.1 HCWs Exposed to CMV

There are no modifications of work practices or work restrictions for HCWs exposed to CMV.

OH should not reassign exposed HCWs who are pregnant or planning to be pregnant[124,125,131,133-140]. **AII**

2.2.4.2 HCWs Symptomatic or Infected with CMV

OH should refer HCWs symptomatic or infected with CMV for confirmation of diagnosis and clinical management, which may include laboratory investigation and antiviral therapy. **AIII**

There are no modifications of work practices or work restrictions for HCWs symptomatic or infected with CMV[125,135,141]. **BIII**

2.2.4.3 OH Management of CMV Outbreak

No outbreaks documented.

2.2.4.4 OH Reporting to Public Health Authorities of HCWs with CMV

There is no reporting requirement for a single case; OH should report a suspected or confirmed outbreak to public health authorities as required by legislation.

3. Education of HCWs about Prevention and Management of Exposure to or Infection with CMV

OH should design education specific to CMV according to the recommendations outlined in Section A-3, to include

- hand hygiene and appropriate use of gloves to reduce transmission[24,124,127-129],
- seroprevalence in population,
- risk to seronegative immunocompromised patients from transfusion or grafted tissue/organs,
- possibility of sexual acquisition if seronegative,
- occurrence of reactivation if seropositive,
- evidence against occupational risk,
- potential risk of acquisition for susceptible pregnant women and the importance of good hand hygiene during the delivery of care to all patients[24]. **AIII**

4. Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infection with CMV

OH should refer to Section A-4 to develop an evaluation program specific to CMV. **AIII**

Diphtheria

1. Risk Assessment for Transmission of Diphtheria to HCWs

1.1 Clinical Significance of Diphtheria

Diphtheria is caused by *Corynebacterium diphtheriae*. It usually occurs as an acute membranous nasopharyngitis and/or obstructive laryngotracheitis and may have life-threatening complications, including myocarditis and neurologic problems. Occasionally, other mucous membranes or skin may be infected[24]. Asymptomatic colonization also occurs.

Strains of diphtheria may be toxigenic or non-toxigenic[24]. Disease is associated with toxigenic strains, which produce an exotoxin that acts locally to produce the laryngeal membrane and systemically to damage cells.

Infection can occur in immunized persons. Disease is most common and most severe, however, in those not immunized or partially immunized[24].

Exposure to toxigenic *C. diphtheriae* has become rare. Data from the Notifiable Diseases Annual Summary, Health Canada, indicate that two to five cases were reported annually between 1986 and 1995 inclusively; no cases were reported in 1996, and a single case was reported in 1997: a total of 33 cases for the 12-year period[142].

An important factor for the resurgence of diphtheria in the Russian Federation and the Ukraine was noted to be the presence of highly susceptible child and adult populations due to a breakdown in immunization systems[143].

Studies suggest that between 20% and 60% of older adults in developed countries are susceptible to diphtheria because exposure to toxigenic *C. diphtheriae* has become rare, and vaccine-induced immunity wanes over time unless periodic boosters are given[144-150]. A recent Canadian study of healthy adults revealed a 20% lack of protective antibody to diphtheria (20.3% of 1,619 sera specimens tested); the remaining sera demonstrated detectable antibody and presumed immunity[151].

Diphtheria protection can be reinforced by recommending that persons requiring a booster dose of tetanus toxoid for wound management receive Td (diphtheria and tetanus toxoid combined)[8,142].

1.2 Evidence of Exposure/Transmission of Diphtheria

In a recent report, 94 hospital employees were exposed to an unimmunized 25-month-old child who died of respiratory diphtheria. Closeness of contact was not systematically ascertained because cultures had not been obtained and culture media were unavailable. Eight of ninety-four HCWs (9%) had received diphtheria toxoid within the previous 5 years, 74 (79%) during the previous 6-10 years, and 12 (13%) more than 10 years earlier. Of the 86 in the latter two groups, 72 were given a booster dose of diphtheria toxoid and 14 were lost to follow-up. Of the 12 who had not received a dose within the previous 10 years, 4 received erythromycin prophylaxis and 8 were lost to follow-up. Sibling contacts of the case had pharyngeal cultures positive for the same strain, but no additional cases developed[152].

During a prolonged community outbreak, a hospital intern acquired symptomatic pharyngeal diphtheria. In addition, a microbiologist who had surveyed the residential apartments of those infected had asymptomatic pharyngeal infection[153].

Recommendations

Compliance with the recommendations for the components of an OH program outlined in Section A–1-4 is required in addition to the following specific recommendations for diphtheria.

2. Risk Control Measures

2.1 Risk Control Measures to Prevent HCW Exposure to or Infection with Diphtheria

2.1.1 *Engineering Controls*

See Section A-2.1.1.

2.1.2 *Administrative Controls*

See Section A-2.1.2.

2.1.3 *OH Work Practices*

OH should document the immune status of HCWs at the preplacement examination[8,143]. **AIII**

OH should consider all HCWs to be susceptible to diphtheria: immunization may not be fully protective against infection since immunity is antitoxic, i.e. protects against serious disease[142]. **AIII**

OH should ensure that all HCWs have had a complete primary series of 3 doses of a combined tetanus and diphtheria (Td) preparation, unless contraindicated[8,142]. **AIII**

OH should ensure optimal levels of diphtheria antibody by updating immunization every 10 years or, at a minimum, by providing a Td vaccine booster at least once for

adults, e.g. at age 50 if it has been 10 years or more since the last booster and there are no contraindications[8,142,153]. **AIII**

OH should provide an injured HCW with a booster dose of Td to promote diphtheria coverage when tetanus toxoid prophylaxis is indicated for wound management[8,142]. **AIII**

2.1.4 *Personal Protective Equipment*

OH should advise HCWs to wear gloves when entering the single room or designated bedspace in a shared room of a patient for whom Contact Precautions are in place for suspected or confirmed diphtheria, and to wear a gown if direct contact with the patient or environmental surfaces is likely[4]. **BII**

OH should advise HCWs to wear a surgical/procedure mask if they are within 1 m (1 metre) of a patient for whom Droplet Precautions are in place for suspected or confirmed diphtheria[4]. **BIII**

2.2 Risk Control Measures to Manage HCWs Exposed to or Infected with Diphtheria

2.2.1 *Assessment of HCW Exposure to Diphtheria*

2.2.1.1 Method of Transmission of Diphtheria

Diphtheria is transmitted primarily by droplet contact of oral or nasal mucous membranes with the oropharyngeal secretions of an infected individual or asymptomatic carrier; it is rarely transmitted by direct contact with skin lesions or articles soiled with lesion discharge from infected individuals.

2.2.1.2 Definition of Occupational Exposure to Diphtheria

OH should define HCW exposure as droplet contact of HCWs' oral or nasal mucous membranes with oropharyngeal secretions infected with a toxigenic strain of *C. diphtheriae;* or direct contact of non-intact skin or mucous membranes with drainage from skin lesions infected with a toxigenic strain of *C. diphtheriae*. **AIII**

2.2.2 *Assessment of Source of HCW Exposure*

In collaboration with IC, OH should confirm the diagnosis of the source and assess the potential for communicability at the time of HCW exposure. **AIII**

2.2.2.1 Communicability of Source

The incubation period for diphtheria is 2 to 5 days. The period of communicability is usually 2 weeks to several months if untreated. When treated, the period of communicability is greatly reduced, usually lasting less than

4 days. Occasionally, chronic carriage occurs even after administration of antimicrobial therapy[4,24,142].

2.2.3 *Criteria to Confirm the Diagnosis of Diphtheria*

Clinical illness – upper respiratory tract infection with or without nasopharyngeal membrane, stridor or cardiac/neurologic involvement; cutaneous presentation or manifestations – variable

Plus – laboratory evidence: bacterial culture of appropriate clinical specimen positive for toxigenic *C. diphtheriae*; histopathologic test results diagnostic for diphtheria

Or – compatible clinical illness in a HCW who is epidemiologically linked to a case confirmed in the previous 2 weeks

2.2.4 *OH Work Practices to Manage HCWs Exposed to or Infected with Diphtheria*

2.2.4.1 HCWs Exposed to Diphtheria

OH should consider all HCWs to be susceptible to diphtheria: immunization may not be fully protective against infection since immunity is antitoxic, i.e. protects against serious disease[142]. **AIII**

OH should promptly initiate follow-up of HCWs exposed to patients known or suspected to be infected with toxigenic *C. diphtheriae* in collaboration with IC[23,24,142]. **AIII**

OH should refer exposed HCWs for clinical management, which should include

a) evaluation for evidence of disease, i.e. fever, sore throat, or skin lesions daily for 7 days from last contact[24,142,152,154],

b) nasal and pharyngeal cultures to be obtained before antibiotics are started[23,24,142,152,154],

c) administration of antibiotics while culture results are awaited; consider the intramuscular route instead of the oral route if the exposed HCW is expected to be noncompliant with the antibiotic regimen[23,24,142,154],

d) administration of a dose of Td vaccine to exposed HCWs who

- are not fully immunized,
- do not know their immunization status,
- have not been immunized in the previous 10 years[23,24,142,153]. **AIII**

OH should exclude exposed HCWs from work until initial cultures are reported to be negative for toxigenic *C. diphtheriae*[142,152]. **BIII**

2.2.4.2 HCWs Colonized, Symptomatic or Infected with Diphtheria

OH should refer HCWs colonized with toxigenic *C. diphtheriae* for clinical management, which should include

- repeat of nasal and pharyngeal cultures (culture twice, at least 24 hours apart) at least 2 weeks after antibiotics are completed[23,24,142,152,154],
- re-treatment with antibiotics if cultures remain positive[142,152,154]. **AIII**

OH should refer HCWs symptomatic or infected with toxigenic *C. diphtheriae* for confirmation of diagnosis and for clinical management; these should include laboratory investigation and antimicrobial treatment. If diphtheria is strongly suspected, specific treatment with antibiotics and antitoxin should be initiated while diagnostic studies are pending and should be continued even if cultures are reported to be negative[23]. **AIII**

OH should exclude HCWs colonized or infected with toxigenic *C. diphtheriae* until effective antibiotics have been taken, two sets of nasal and pharyngeal cultures taken 24 hours apart after cessation of antibiotics are negative, and the HCW has been clinically assessed prior to return to work[24,78,142,152]. **BIII**

OH should inform IC as soon as possible of a suspected or confirmed case of diphtheria. **AIII**

2.2.4.3 OH Management of Diphtheria Outbreak

OH should consider the possibility of an outbreak if more than one HCW on the same unit meet the criteria for diagnosis. **AIII**

OH should liaise with IC and public health authorities if an outbreak is suspected. **AIII**

In consultation with IC, OH may modify work restrictions as necessary in outbreak situations. **BIII**

2.2.4.4 OH Reporting to Public Health Authorities of HCWs with Diphtheria

OH should report a case or a suspected/confirmed outbreak to public health authorities as required by legislation.

3. Education of HCWs about Prevention and Management of Exposure to or Infection with Diphtheria

OH should design education specific to diphtheria according to the recommendations outlined in Section A-3, to include

- immunization and prophylaxis recommendations,

- importance for follow-up to obtain culture results and to report if prophylaxis is not tolerated. **AIII**

4. Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infection with Diphtheria

OH should refer to Section A-4 to develop an evaluation program specific to diphtheria, including

- rates of exposure and infection,
- time lost due to exposures and infections. **AIII**

Epstein-Barr Virus (EBV)

1. Risk Assessment for Transmission of EBV to HCWs

1.1 Clinical Significance of EBV

EBV is a herpesvirus and the most common cause of infectious mononucleosis. The spectrum of primary disease is extremely variable, including fever, exudative pharyngitis, lymphadenopathy, hepatosplenomegaly and rash, but the disease is frequently asymptomatic. Relapsing disease is also associated with EBV in immunosuppressed individuals, e.g. transplant patients and those with HIV, manifested in a variety of complex syndromes. As well, EBV is associated with other disorders and neoplasms[24].

1.2 Evidence of Exposure/Transmission of EBV

Infection is frequently contracted early in life and is common in lower socioeconomic groups, in which intrafamilial spread is common. Endemic infectious mononucleosis is common in group settings of adolescents, e.g. educational institutions[24].

Occupational transmission has rarely been reported[155,156].

Transmission to 9 of 29 HCWs (31%) in an obstetrics and gynecology clinic occurred over a 4 week period and was considered to be due to sharing of non-disposable, poorly washed coffee cups. Five of the nine developed clinical disease with serologic confirmation, and four of the nine had primary asymptomatic EBV infection[155].

A study investigating work-related infections with human herpesviruses among dental personnel suggested a possible occupational risk with infection of EBV in dentists. The authors noted that since the emergence of AIDS, cross infection practices in dentistry have changed greatly. They found no correlations between the use of protective workwear by dentists during their practising lifetimes and their serostatus with respect to EBV and other herpesviruses[156].

Recommendations

Compliance with the recommendations for the components of an OH program outlined in Section A–1-4 is required in addition to the following specific recommendations for EBV.

2. Risk Control Measures

2.1 Risk Control Measures to Prevent HCW Exposure to or Infection with EBV

2.1.1 *Engineering Controls*

See A-2.1.1.

2.1.2 *Administrative Controls*

See Section A-2.1.2.

2.1.3 *OH Work Practices*

See Section A-2.1.3.

2.1.4 *Personal Protective Equipment*

See Section A-2.1.4.

2.2 Risk Control Measures to Manage HCWs Exposed to or Infected with EBV

2.2.1 *Assessment of HCW Exposure to EBV*

2.2.1.1 Method of Transmission of EBV

EBV is transmitted by direct contact of oral mucous membranes with infectious saliva or indirectly through contaminated items.

2.2.1.2 Definition of Occupational Exposure to EBV

OH should define exposure as direct or indirect contact of oral mucous membranes with infectious saliva. **AIII**

2.2.2 *Assessment of Source of HCW Exposure*

In collaboration with IC, OH should confirm the diagnosis of the source and assess the potential for communicability at the time of HCW exposure. **AIII**

2.2.2.1 Communicability of Source

The incubation period is 30 to 50 days[4]. The period of communicability is indeterminate[24].

2.2.3 *Criteria to Confirm the Diagnosis of EBV*

Clinical illness – fever, exudative pharyngitis, lymphadenopathy, hepatosplenomegaly

Plus – laboratory evidence: heterophile antibody, e.g. Monospot positive; IgM to viral capsid antigen (VCA) positive for EBV; EBV IgG positive in a previously seronegative individual; EBV PCR positive.

2.2.4 *OH Work Practices to Manage HCWs Exposed to or Infected with EBV*

2.2.4.1 HCWs Exposed to EBV

There are no modifications of work practices or work restrictions for HCWs exposed to EBV.

2.2.4.2 HCWs Symptomatic or Infected with EBV

There are no modifications of work practices or work restrictions for HCWs symptomatic or infected with EBV.

2.2.4.3 OH Management of EBV Outbreak

There are no work restrictions in outbreaks.

2.2.4.4 OH Reporting to Public Health Authorities of HCWs with EBV

There is no reporting requirement for a single case; OH should report a suspected or confirmed outbreak to public health authorities as required by legislation.

3. Education of HCWs about Prevention and Management of Exposure to or Infection with EBV

OH should design education specific to EBV according to the recommendations outlined in Section A-3. **AIII**

4. Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infection with EBV

OH should refer to Section A-4 to develop an evaluation program specific for EBV. **AIII**

Herpes Simplex Virus (HSV)

1. Risk Assessment for Transmission of HSV to HCWs

1.1 *Clinical Significance of HSV*

Herpes simplex lesions are caused by either HSV type 1 or 2. The viruses produce distinct clinical syndromes and may infect any body site. Like other herpesviruses, HSV infection is characterized by a localized primary lesion, latency, and a tendency to localized recurrence. Reactivation of latent infection of HSV, which is most common in adults, results in herpes labialis (fever blisters or cold sores) or genital lesions. Primary and recurrent infection can occur, with or without symptoms[23].

Neonatal HSV infection is usually symptomatic and frequently severe, with high morbidity and mortality. In immunocompromised patients severe local lesions and occasionally disseminated HSV with generalized vesicular skin lesions and visceral involvement can occur[24].

Viral shedding can occur during recurrences and also in the absence of clinical signs[24,157-159].

1.2 *Evidence of Exposure/Transmission of HSV*

Infection of the fingers (herpetic whitlow) is a distinct hazard for nurses, anesthesiologists[160], dentists[161,162], respiratory care personnel, and other HCWs who may have direct (usually hand) contact with either oral lesions or respiratory secretions of infected patients[158,163].

Until additional studies determine how well gloves prevent the transmission of HSV from herpetic whitlow it is prudent to restrict HCWs with herpetic whitlow from working with patients until the lesions are healed[30].

Areas of non-intact skin, i.e. minor cuts, abrasions, or other skin lesions are the most likely sites of HSV infection in HCWs[158].

The rate of work-related transmission is unknown because many infections go unrecognized or undiagnosed[158].

The authors of one report described a cluster of HSV infections involving seven HCWs with manifestations including keratoconjunctivitis (1), whitlow (3), perioral infection (1), pharyngitis (1) and throat carriage (1) from contact with infectious body secretions. They

concluded that transmission was probably a result of poor compliance with infection control protocols or ineffective protocols[164].

Cross infection between patients and nurses in a pediatric intensive care unit (PICU) provided clear evidence that PICU HCWs risk acquiring serious herpetic infections, i.e. acute pharyngitis or whitlow from patients and vice-versa unless careful attention to infection prevention and control is practised[163].

A report of 54 cases of probable herpetic whitlow in HCWs occurring in a neurosurgical unit was published in 1959. The lesions were initially thought to be staphylococcal. Once viral studies had been initiated, HSV was recovered from 13 HCWs[159].

The risk to patients posed by HCWs with orofacial herpes is unknown, but transmission has been reported[165].

Postnatal transmission of HSV to an infant from a HCW with herpes labialis was confirmed by molecular analysis. The transmission occurred during direct tracheal suctioning for meconium aspiration in the delivery room. The physician involved wore a mask as a barrier against resolving coldsores when suctioning via an endotracheal tube[165].

Evidence is lacking that HCWs with genital infection pose any risk to patients[141].

Recommendations

Compliance with the recommendations for the components of an OH program outlined in Section A–1-4 is required in addition to the following specific recommendations for HSV.

2. Risk Control Measures

2.1 Risk Control Measures to Prevent HCW Exposure to or Infection with HSV

2.1.1 *Engineering Controls*

See Section A-2.1.1.

2.1.2 *Administrative Controls*

See Section A-2.1.2.

2.1.3 *OH Work Practices*

See Section A-2.1.3.

2.1.4 *Personal Protective Equipment*

OH should advise HCWs to wear gloves when entering the single room or designated bedspace of a shared room of a neonatal patient suspected or confirmed to have HSV, or an adult or pediatric patient suspected or confirmed to have mucocutaneous (disseminated or primary and extensive) HSV for whom Contact Precautions are in

place; as well, they should wear a gown if direct contact with the patient or environmental surfaces is likely[4]. **BII**

2.2 Risk Control Measures to Manage HCWs Exposed to or Infected with HSV

2.2.1 *Assessment of HCW Exposure to HSV*

2.2.1.1 Method of Transmission of HSV

HSV is transmitted by direct or indirect contact with primary or recurrent lesions, infectious saliva, or genital secretions and possibly all body secretions/excretions from infected neonates.

2.2.1.2 Definition of Occupational Exposure to HSV

OH should define exposure as direct or indirect contact of non-intact skin or mucous membranes with infectious oral or genital secretions, lesion drainage, or any secretions or excretions from an infected neonate. **AIII**

2.2.2 *Assessment of Source of HCW Exposure*

In collaboration with IC, OH should confirm the diagnosis of the source and assess the potential for communicability at the time of HCW exposure. **AIII**

2.2.2.1 Communicability of Source

The incubation period is 2 days to 2 weeks[4]. The period of communicability is at least until lesions are healed; asymptomatic viral shedding may occur intermittently; neonatal infection may involve shedding of virus for the duration of illness.

2.2.3 *Criteria to Confirm Diagnosis of HSV*

Clinical illness – primary or recurrent vesicular/ulcerative lesions of skin or mucous membrane; encephalitis/meningitis, localized CNS disease; generalized systemic infection of neonate

With or Without laboratory evidence – viral culture of an appropriate clinical specimen positive for HSV; immunofluorescence positive clinical specimen; HSV viral DNA positive (available in some reference laboratories)

2.2.4 *OH Work Practices to Manage HCWs Exposed to or Infected with HSV*

2.2.4.1 HCWs Exposed to HSV

There are no modifications of work practices or work restrictions for HCWs exposed to HSV.

2.2.4.2 HCWs Symptomatic or Infected with HSV

OH should instruct HCWs with orofacial or weeping lesions to wear a protective dressing during patient care to prevent hand contact with lesions[141] and should emphasize handwashing[24]. **AIII**

OH should refer HCWs with herpetic whitlow or weeping lesions for confirmation of diagnosis and for clinical management; these may include laboratory investigation and oral antiviral therapy[167]. **AIII**

OH should exclude HCWs with orofacial or weeping lesions that are on sites other than hands and that cannot be covered with a protective dressing from having direct contact with high-risk patients, such as newborns, burn patients, or immunocompromised patients[30,160,163,165,168] and should reassign to patients not at high risk after assessment for fitness for work[24]. **AII**

OH should exclude HCWs with herpetic infections of the fingers or hands (herpetic whitlow) from having direct contact with patients until lesions are healed[30,160,163,169] or should reassign them to non-patient care tasks. Ensure that hygiene and handwashing are not compromised. **AIII**

OH should assess the HCW's fitness for work by evaluating the resolution of symptoms; type of patient/work/physical setting, hygiene practices, and the control measures that can be used; and by establishing a follow-up schedule[156,165]. **AIII**

OH should not exclude HCWs with genital HSV lesions[24]. **AIII**

2.2.4.3 OH Management of HSV Outbreak

OH should consider the possibility of an outbreak if more than one HCW on the same unit meet the criteria for diagnosis. **AIII**

OH should liaise with IC and public health authorities if an outbreak is suspected. **AIII**

2.2.4.4 OH Reporting to Public Health Authorities of HCWs with HSV

There is no reporting requirement for a single case; OH should report a suspected or confirmed outbreak to public health authorities as required by legislation.

3. Education of HCWs about Prevention and Management of Exposure to or Infection with HSV

OH should design education specific to HSV according to the recommendations outlined in Section A-3, to include

- the use of dressings to cover lesions,
- the importance of not touching lesions,
- the importance of not nuzzling/kissing newborn infants or a child with dermatitis[24],
- the importance of not sharing potentially contaminated facial or lip make-up. **AIII**

4. Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infection with HSV

OH should refer to Section A-4 to develop an evaluation program specific to HSV, including

- rates of infection,
- time lost due to infections. **AIII**

Influenza

1. Risk Assessment for Transmission of Influenza to HCWs

1.1 Clinical Significance of Influenza

Influenza is an acute, viral disease of the respiratory tract characterized by fever, headache, myalgia, prostration, coryza, sore throat, and cough[23].

Two main types of influenza virus are recognized: influenza A, associated with widespread outbreaks and pandemics, and influenza B[23].

Influenza is important because it causes yearly outbreaks with widespread morbidity, including serious complications such as viral and bacterial pneumonia. During major epidemics severe illness and death occur, especially among the elderly and those with chronic cardiorespiratory and metabolic illnesses. The excess mortality, i.e. proportion of total deaths associated with pneumonia and influenza in excess of the proportion expected for the time of year, varies from epidemic to epidemic and is related to the circulating virus strain[23].

1.2 Evidence of Exposure/Transmission of Influenza

Immunization is recognized as the single most effective way of preventing or attenuating illness for those at high risk of serious illness or death[8,170].

Influenza vaccination has substantial health-related and economic benefits for healthy working adults[171] and is not associated with systemic side effects in healthy adults[172].

Immunization of HCWs working in long-term care reduces the mortality and morbidity of patients under their care[8,170]. It also reduces HCW illness during the influenza season.

A study was carried out to determine whether vaccination of HCWs caring for geriatric patients in long-term care and vaccination of patients in long-term care reduce the patient incidence of influenza and associated morbidity and mortality. Vaccination of HCWs was associated with reductions in total patient mortality (from 17% to 10%) and influenza-like illness, but vaccination of patients was not associated with significant effects on mortality[173].

Employee absenteeism is an indirect method to assess the impact of influenza on HCWs[174].

In the majority of reports of nosocomial influenza, most HCWs have not been immunized during fall campaigns and were not immunized or given chemoprophylaxis during outbreaks in their hospitals[175].

Immunization rates among HCWs in some hospitals have been reported to be as low as 2% to 16%[176,177]. One of the most important strategies for increasing immunization levels among HCWs is to educate them about vaccine safety and the reasons for targeting HCWs for immunization[170,178,179].

Vaccine uptake by HCWs in institutions has been increased by making vaccination accessible, e.g. through the use of mobile carts[180,181] and by making vaccination a requirement of employment.

In a study to determine the effectiveness of immunization, the authors concluded that their data support a policy of annual influenza vaccination. Their results showed that influenza vaccine was effective in preventing infection by influenza A and B in HCWs and may have reduced reported days of work absence and febrile respiratory illness[182].

One outbreak in a large (1,156 bed) hospital resulted in influenza in 118 HCWs and 49 patients. The authors believed the outbreak was exacerbated by spread of the virus in the workplace to susceptible physicians, nurses, and patients. Only 25 medical personnel had been immunized during the annual program that preceded the outbreak. Active education and the use of a mobile cart to minimize inconvenience to staff resulted in about one-third of all medical personnel being immunized during the outbreak[181].

A 1996 review of influenza in U.S. hospitals between 1959 and 1994 identified 17 reports of influenza outbreaks. In most of the reports HCWs were ill at the same time influenza was recognized in patients. However, HCW-to-patient influenza transmission was suspected in only five instances. The authors concluded that HCWs rarely comply with preventive measures, and few institutions have formal influenza control policies[175].

Recommendations

Compliance with the recommendations for the components of an OH Program outlined in Section A–1-4 is required in addition to the following specific recommendations for influenza.

2. Risk Control Measures

2.1 Risk Control Measures to Prevent HCW Exposure to or Infection with Influenza

2.1.1 *Engineering Controls*

See Section A-2.1.1.

2.1.2 *Administrative Controls*

See Section A-2.1.2.

2.1.3 *OH Work Practices*

OH should consider all HCWs to be susceptible to influenza. This is because strains change annually, the immunization has an efficacy of about 70% to 80%, the vaccine has a short protective period of about 6 months, and the vaccine components change annually[8,23,24]. **AIII**

NACI advises providing annual immunization *only* to HCWs who have significant contact with individuals in high-risk groups. Such personnel include physicians, nurses, and others in both hospital and outpatient settings; HCWs of chronic-care facilities who have contact with residents; providers of home care, visiting nurses or volunteers; and household members of persons at high risk[8,170]. However, all HCWs are at greater risk of exposure to and transmission of influenza. *Therefore, irrespective of whether HCWs have direct contact with high-risk individuals*, OH should ensure that *all* HCWs are offered annual influenza immunization unless there are contraindications[175,180-182]. **AII**

OH and Administration should consider making annual influenza immunization a requirement of employment in the long-term care setting[173]. **AI**

OH should ensure that immunization initiatives are included in staffing contractual agreements with external service providers, e.g. emergency responders, academic institutions. **AIII**

OH should consider various methods to increase accessibility, e.g. mobile carts[170,180,181], and simultaneous immunization of patients and HCWs[183], to improve vaccine coverage[181,184,185]. **AIII**

2.1.4 *Personal Protective Equipment*

OH should advise HCWs to wear a surgical/procedure mask if they are within 1 m of a pediatric patient for whom Droplet Precautions are in place for suspected or confirmed influenza. Droplet Precautions are optional for adult patients[4]. **BIII**

OH should advise HCWs to wear gloves when entering the single room or designated bedspace in a shared room of a pediatric patient for whom Contact Precautions are in place for suspected or confirmed influenza and to wear a gown if direct contact with the patient or environmental surfaces is likely. Contact precautions are optional for adult patients[4]. **BII**

2.2 Risk Control Measures to Manage HCWs Exposed to or Infected with Influenza

2.2.1 *Assessment of HCW Exposure to Influenza*

2.2.1.1 Method of Transmission of Influenza

Influenza is transmitted primarily by droplet contact of the oral, nasal, or possibly conjunctival mucous membranes with the oropharyngeal secretions of an infected individual and indirectly from hands and articles freshly soiled with discharges of the nose and throat of an acutely ill and coughing individual; airborne transmission is possible[4].

2.2.1.2 Definition of Occupational Exposure to Influenza

OH should define exposure as droplet or indirect contact of oral, nasal, or conjunctival mucous membranes with infectious respiratory secretions. **AIII**

2.2.2 *Assessment of Source of HCW Exposure*

In collaboration with IC, OH should confirm the diagnosis of the source and assess the potential for communicability at the time of HCW exposure. **AIII**

2.2.2.1 Communicability of Source

The incubation period is 1 to 3 days. The period of communicability is 1 day before to 7 days after the onset of symptoms and may be longer in infants[4].

2.2.3 *Criteria to Confirm the Diagnosis of Influenza*

Clinical illness – sudden onset of fever, chills, headache, myalgias, respiratory tract symptoms

Plus laboratory evidence – viral culture of the nasopharynx positive for influenza; direct antigen test positive for influenza; significant rise in influenza IgG antibody

Or – compatible clinical illness in a HCW during an outbreak

2.2.4 *OH Work Practices to Manage HCWs Exposed to or Infected with Influenza*

2.2.4.1 HCW Exposure to Influenza

OH should consider all HCWs to be susceptible to influenza: strains change annually, immunization has an efficacy of about 70% to 80%, the vaccine has a short protective period of about 6 months, and the vaccine components change annually[8,23,24]. **AIII**

OH should arrange for immunization of unimmunized exposed HCWs as soon as possible[8,170]. **AIII**

There are no work restrictions for HCWs exposed to influenza.

OH should refer immunocompromised, unimmunized, exposed HCWs for clinical management that may include consideration of immunization and antiviral prophylaxis[170,174]. **BIII**

2.2.4.2 HCWs Symptomatic or Infected with Influenza

OH should refer HCWs symptomatic or infected with influenza for confirmation of diagnosis and for clinical management; these may include

- laboratory investigation,
- consideration of antiviral therapy as a supplement to vaccine if the interval since immunization is less than 2 weeks[170]. **AIII**

OH should exclude HCWs symptomatic or infected with influenza from work until 7 days after the onset of symptoms[4] unless they have been immunized at least 2 weeks previously and have started antiviral therapy. **AIII**

OH should minimize contact between HCWs with acute respiratory infection and high-risk patients (e.g. pediatric patients with significant hemodynamic congenital heart disease, immunocompromised patients). **BIII**

OH should inform IC of a case of suspected or confirmed influenza as soon as possible if there has been little to no influenza activity. **AIII**

2.2.4.3 OH Management of Influenza Outbreak

OH should consider the possibility of an outbreak if more than one HCW on the same unit meet the criteria of diagnosis during the influenza season. **AIII**

OH should liaise with IC and public health authorities if an outbreak is suspected. **AIII**

OH should refer unimmunized HCWs for clinical management, which may include

- prescribing antiviral prophylaxis for the duration of the outbreak if vaccine is unavailable, if it was given less than 2 weeks prior to exposure, or if it is contraindicated,
- immunizing and prescribing a 2 week course of antiviral prophylaxis[8,170,174,186]. **AIII**

In collaboration with IC, OH should consider the need for flexibility and re-evaluation of work restrictions in the outbreak management plan to maintain adequate staffing as necessary in outbreaks. **AIII**

In collaboration with IC, OH should consider limiting staff movement among affected and non-affected units or facilities during an outbreak. **BIII**

OH should advise HCWs who are symptomatic or infected with influenza not to work in units/facilities not affected with influenza. **BIII**

OH should exclude unimmunized HCWs who refuse to cooperate with the outbreak plan (antiviral prophylaxis and immunization)[173]. **AII**

2.2.4.4 OH Reporting to Public Health Authorities of HCWs with Influenza

OH should report a case or a suspected or confirmed outbreak to public health authorities as required by legislation.

3. Education of HCWs about Prevention and Management of Exposure to or Infection with Influenza

OH should design education specific to influenza according to the recommendations outlined in Section A-3, to include

- the various types of influenza (type A/type B),
- the difference between an upper respiratory infection and influenza,
- the risk of infection and subsequent complications in high-risk groups,
- the reason why HCWs are targeted for immunization[178],
- the importance and safety of immunization for staff or patients, including legislative or other requirements related to influenza,
- the reason why HCWs may be susceptible even if immunized,
- prophylaxis recommendations. **AIII**

4. Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infection with Influenza

OH should refer to Section A-4 to develop an evaluation program specific to influenza, including:

- rate of employee absenteeism during influenza season,
- vaccination rate,
- number of occupational cases,
- number of nosocomial transmissions due to HCW infection. **AIII**

Measles (Rubeola)

1. Risk Assessment for Transmission of Measles to HCWs

1.1 Clinical Significance of Measles

Measles is a highly communicable, febrile viral illness that is characterized by Koplik's spots on the buccal mucosa, cough, coryza, conjunctivitis, and an erythematous rash. Complications may result from viral replication or bacterial superinfection and include otitis media, pneumonia, croup, diarrhea, and encephalitis. The disease is more severe in immuno-compromised children[24], infants and adults[23].

One study reported that 26% of HCWs who acquired measles required hospitalizations, with an average duration of 7 days for such complications as pneumonia and encephalopathy. Death occurs occasionally[187].

1.2 Evidence of Exposure/Transmission of Measles

Measles virus can survive at least 2 hours in evaporated droplets, and the airborne spread of these fine particles has been implicated in many closed settings[188], including outbreaks in health care settings that occurred when the index patients were no longer present[189,190].

Since national reporting for measles began in Canada in 1924, the annual incidence has ranged from 0.04 to 767 cases per 100,000 population. In 1998, Canada had the lowest level of measles activity — only 12 cases — ever recorded. A total of 581 cases were reported in 1997[191].

It has been estimated that about 10% of vaccinated children remain unprotected after a single dose of vaccine[8]. Canadian territories and provinces have committed themselves to eliminate measles by the year 2005. A 2-dose vaccine schedule has been adopted and augmented by mass vaccination "catch-up" programs and heightened surveillance[191,192].

Two recent studies reported the seroprevalence of measles (rubeola) in HCWs: 6% to 10% of new or current medical personnel lacked measurable antibodies and thus were presumed to be susceptible to infection[193,194].

A survey to investigate the role medical students play in measles and rubella outbreaks in Canada and the U.S. found that, since 1981, 9% percent of health departments have

recorded at least one outbreak of rubella or measles in which medical students were specifically implicated as sources or vectors[195].

In Canada, NACI states that persons born before 1970 have probably been infected naturally and may usually be considered to be immune[8].

The Advisory Committee on Immunization Practices and the Hospital Infection Control Practices Advisory Committee in the United States state that birth before 1957 is generally considered acceptable evidence of measles immunity, although recommendations state that vaccination should be considered for all susceptible HCWs, including those born before 1957[78]. Other reports challenge the 1957 rule[187,193,194,196].

Between 1985 and 1989, physicians and nurses were estimated to be two and eight times, respectively, more likely to acquire measles than adults who are not HCWs[198].

Because of an increase in the incidence of measles, mumps and rubella among U.S. adults, a study to determine antibody prevalence rates among U.S. army recruits was completed. The authors reported that as many as 16% to 18% of young adults may be susceptible to measles, mumps and rubella[199]. The opportunity to ensure immunity to these viruses should not be overlooked[187].

From 1985 to 1991, 4% of all U.S. cases[187] of measles occurred in medical settings and almost half of these were in hospital inpatient units. Physicians' offices and hospital emergency departments accounted for the other half. Adults (over 18 years) accounted for 41% of cases in medical settings; 14% percent were patients, and 64% were HCWs. The remainder included visitors or persons for whom occupations could not be determined. Of the HCWs, nurses accounted for the largest group who acquired measles at work (29%), and physicians accounted for 15%. Other groups included laboratory and radiology personnel and clerks, for 11% each, and nursing assistants, and medical and nursing students for 4% each[187,198].

In a review of measles cases occurring in medical settings in a < 3 month period, 8 of 31 cases (26%) occurred in HCWs, and 16% occurred in patients or visitors to the medical facilities. Cases of measles occurred in HCWs who were not required to have proof of measles immunity. The authors concluded that HCWs were at higher risk of measles than the general adult population as a result of deficiencies in, and lack of implementation of, published guidelines[200].

Recommendations

Compliance with the recommendations for the components of an OH program outlined in Section A–1-4 is required in addition to the following specific recommendations for measles.

2. Risk Control Measures

2.1 Risk Control Measures to Prevent HCW Exposure to or Infection with Measles

2.1.1 *Engineering Controls*

OH should liaise with Infection Control and Engineering/Physical Plant to ensure that appropriately maintained negative pressure rooms are available for patients suspected or confirmed to have measles[4]. **AIII**

2.1.2 *Administrative Controls*

See Section A-2.1.2.

2.1.3 *OH Work Practices*

OH should document HCW immune status at the preplacement examination[8,33,193,194,201]. **AII**

OH should consider HCWs to be immune to measles if they were born before 1970; or if they were born in or after 1970 and have evidence of two doses of live measles-containing vaccine, physician-diagnosed measles, or documentation of measles IgG[8,187,193,194,198]. **AIII**

OH should immunize all susceptible HCWs with two doses of live measles-containing vaccine given as measles, mumps and rubella (MMR) at least 1 month apart unless there are contraindications[8,78,187,192-194,196,202]. **AII**

OH should ensure that a second dose of measles vaccine (MMR) is given to HCWs born in 1970 or after who have previously received only one dose, to provide optimal protection[8]. **AIII**

OH should develop a program to ensure that all newly employed, susceptible HCWs with patient contact are immunized, and consider a "catch-up" program for others; workplaces may vary in how they put this into operation[8,192,202]. **AIII**

OH should not routinely initiate a serologic testing program to detect susceptible HCWs unless it is determined to be cost-effective for the workplace[8,201]. **BIII**

OH should not exclude recently immunized HCWs with a vaccine-related rash. **BIII**

OH should ensure that susceptible HCWs do not work with patients suspected or confirmed to have measles[4]. **AIII**

2.1.4 *Personal Protective Equipment*

OH should ensure that HCWs who are susceptible but who absolutely must enter the room of a patient for whom Airborne Precautions are in place for suspected or

confirmed measles are provided with an appropriate mask for respiratory protection against measles. The masks should meet or exceed the following recommendations:

- filters particles ≥ 1 μm (1 micron) in size,
- has a 95% filter efficiency, tested in the unloaded state, and
- provides a tight facial seal (< 10% facial seal leak)[4]. **BIII**

OH should advise HCWs who are immune that a mask is not required[4]. **BIII**

2.2 Risk Control Measures to Manage HCWs Exposed to or Infected with Measles

2.2.1 *Assessment of HCW Exposure to Measles*

2.2.1.1 Method of Transmission of Measles

Measles is transmitted by inhalation of airborne virus by a susceptible individual.

2.2.1.2 Definition of Occupational Exposure to Measles

OH should define exposure as a susceptible HCW spending any time in an enclosed airspace, i.e. in the same room, being in face-to-face contact with an infectious patient in an open area, or being in a room (within 2 hours of an infectious patient being there) supplied by a ventilation system that recirculates contaminated air, during the 5 days before to 4 days after the onset of the rash. **AIII**

2.2.2 *Assessment of Source of HCW Exposure*

In collaboration with IC, OH should confirm the diagnosis of the source and assess the potential for communicability at the time of HCW exposure. **AIII**

2.2.2.1 Communicability of Source

The incubation period is 7 to 18 days. The period of communicability is 5 days before the onset of rash (1-2 days before onset of initial symptoms) until 4 days after onset of rash; this period may be longer in immunocompromised individuals[4].

2.2.3 *Criteria to Confirm the Diagnosis of Measles*

Clinical illness – fever, cough, coryza, conjunctivitis and erythematous maculopapular rash, Koplik's spots

Plus laboratory evidence – IgM antibody positive for measles; four-fold rise in measles IgG antibody; viral culture of an appropriate clinical specimen positive for measles

2.2.4 *OH Work Practices to Manage HCW Exposed to or Infected with Measles*

2.2.4.1 HCWs Exposed to Measles

OH should determine the immune status of the exposed HCW. If this is unknown or only one dose of vaccine was given, OH should test the HCW for IgG antibody[198]. **AIII**

OH should consider the exposed HCW to be immune to measles if born before 1970, or if born in or after 1979 with evidence of two doses of live measles-containing vaccine, physician-diagnosed measles, or documentation of measles IgG[8,187,193,194,198]. **AIII**

OH should immunize the exposed, susceptible HCW with a second dose of live measles vaccine given as MMR within 72 hours of the exposure if the HCW has a history of only one dose of vaccine, unless immunization is contraindicated[8,198]. **AIII**

OH should refer the exposed, susceptible HCW for clinical management, which should include

- immunization with measles vaccine within 3 days of exposure unless contraindicated[8,24],
- administration of immune globulin to the susceptible HCW within 6 days of exposure if > 3 days have passed since exposure or vaccine is contraindicated. The dose of immune globulin for exposed individuals who have underlying malignant disease or who are otherwise immunologically deficient differs from that for healthy individuals. Administration of immune globulin does not alter work restrictions[8].
- immunization with measles vaccine 5 months after immune globulin is given if exposure did not result in infection[8]. **AIII**

OH should refer exposed, susceptible HCWs who are pregnant to their physicians for clinical management. **BIII**

OH should exclude susceptible, exposed HCWs from day 5 after their first exposure until day 21 after their last exposure, regardless of whether postexposure immunization or immune globulin is given[24,33]. **AIII**

OH should not exclude HCWs with a history of a single dose of measles vaccine if a second dose is given within 72 hours of exposure or if they are found to be antibody positive following one dose of vaccine. **AIII**

2.2.4.2 HCWs Symptomatic or Infected with Measles

OH should refer HCWs with measles for confirmation of diagnosis and for clinical management, which should include laboratory investigation and management of complications, e.g. pneumonia. **AIII**

OH should exclude HCWs with measles until 4 days after the rash first appeared[4,24]. **AIII**

OH should inform IC as soon as possible of a suspected or confirmed case of measles. **AIII**

2.2.4.3 OH Management of Measles Outbreak

OH should consider the possibility of an outbreak if more than one HCW on the same unit meet the criteria for diagnosis. **AIII**

OH should liaise with Infection Control and public health authorities if an outbreak is suspected or confirmed. **AIII**

2.2.4.4 OH Reporting to Public Health Authorities of HCWs with Measles

OH should report a case or a suspected or confirmed outbreak to public health authorities as required by legislation.

3. Education of HCWs about Prevention and Management of Exposure to or Infection with Measles

OH should design education specific to measles according to the recommendations outlined in Section A-3. **AIII**

4. Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infection with Measles

OH should refer to Section A-4 to develop an evaluation program specific to measles, to include

- rates of exposure and infections,
- time lost due to exposures and infections,
- cost of tracking exposures and infections for a vaccine preventable disease. **AIII**

Meningococcus *(Neisseria meningitidis)*

1. Risk Assessment for Transmission of Meningococcus to HCWs

1.1 Clinical Significance of Meningococcus

Neisseria meningitidis causes an acute bacterial infection resulting in several major clinical conditions, including bacteremia, sepsis, meningitis, and meningococcemia.

Although the most common and severe pathological presentations are meningitis and meningococcemia, asymptomatic carriage is commonly found[204].

1.2 Evidence of Exposure/Transmission of Meningococcus

During the past decade, the incidence rate of invasive meningococcal disease in Canada has varied from a peak of 1.6 per 100,000 population during 1989 and 1990 to 0.9 per 100,000 in 1996, the lowest rate in 11 years[205]. There were 304 cases reported during 1995, resulting in an incidence rate of 1.0 per 100,000 population; during 1996 the number decreased by 13%, to 265 cases, for an incidence of 0.9 per 100,000.

HCWs have not been found to be at any greater risk of acquiring infection than the general population[206], even when exposed to a patient with fulminant meningococcemia[207].

In a recent retrospective survey in England and Wales that measured the risk to HCWs of being exposed to meningococcal disease, the authors estimated that the attack rate was 0.8 per 100,000 HCWs at risk, 25 times that in the general population. They concluded that the excess risk was small, and inappropriate use of antibiotics for chemoprophylaxis should be avoided[208].

The risk of HCWs acquiring disease from casual contacts, e.g. housekeeping or delivering food to an unisolated patient with unrecognized meningococcal pneumonia, is negligible[209].

Transmission to HCWs has been reported[209,210], although it is rare. Transmission to patients has occurred when the source patient has meningococcal pneumonia resulting in heavy airborne dispersal of organisms.

In 1978, the U.S. Centers for Disease Control and Prevention (CDC) reported that a nurse developed meningococcemia 3 days after assisting with intubation and suctioning of a vomiting patient who had meningococcemia and meningitis. HCWs assisting with these

procedures did not wear masks or follow other isolation procedures and did not receive prophylaxis after exposure[211].

A 1972 article in the *Journal of the American Medical Association* entitled *Some Recollections of the Meningococcal Diseases* noted that at least four HCWs developed disease after performing mouth-to-mouth resuscitation on infected patients. There was no additional information on the use of barriers or prophylaxis[212].

A pediatrician developed meningococcal meningitis after performing endotracheal intubation without protection on a child who was suspected of having meningococcus[213].

Probable laboratory acquired infection has been reported[214,215]. A laboratory worker who prepared a concentrated solution of meningococci without the use of protective barriers died from a strain identical to that of the isolate she worked on[215]. Laboratory workers are probably not at increased risk of infection when standard microbiology practices are followed, i.e. the use of gown, gloves, biologic safety cabinets[214].

Transmission from carriers to HCWs has not been reported[141].

Recommendations

Compliance with the recommendations for the components of an OH program outlined in section A–1-4 is required in addition to the following specific recommendations for meningococcus.

2. Risk Control Measures

2.1 Risk Control Measures to Prevent HCW Exposure to or Infection with Meningococcus

2.1.1 *Engineering Controls*

See Section A-2.1.1.

2.1.2 *Administrative Controls*

Administration should ensure that there are processes in place to provide appropriate contact tracing for emergency responders[19,96-99,114]. **AIII**

2.1.3 *OH Work Practices*

There are no recommendations for routine immunization[8,96-99,114]. **AIII**

In cooperation with appropriate stakeholders, OH should develop a process for involving emergency responders when considering notification of contacts[19]. **AIII**

2.1.4 *Personal Protective Equipment*

OH should advise HCWs to wear a surgical/procedure mask if they are within 1 m of a patient for whom Droplet precautions are in place for suspected or confirmed meningococcus[4]. **BIII**

2.2 Risk Control Measures to Manage HCWs Exposed to or Infected with Meningococcus

2.2.1 *Assessment of HCW Exposure to Meningococcus*

2.2.1.1 Method of Transmission of Meningococcus

Meningococcus is transmitted by direct and droplet contact of oral mucous membranes with infectious oral or nasopharyngeal secretions[216].

2.2.1.2 Definition of Occupational Exposure to Meningococcus

OH should define exposure as direct contact of HCWs' oral mucous membranes with infectious oral or nasopharyngeal secretions during mouth-to-mouth resuscitation or as a result of a spray of secretions, within 7 days of onset and up to 24 hours after the start of effective therapy. **AIII**

2.2.2 *Assessment of Source of HCW Exposure*

In collaboration with IC, OH should confirm the diagnosis of the source and assess the potential for communicability at the time of HCW exposure. **AIII**

2.2.2.1 Communicability of Source

The incubation period is 2 to 10 days. The period of communicability is 7 days prior to onset of symptoms until 24 hours after effective therapy has been started[4].

2.2.3 *Criteria to Confirm the Diagnosis of Meningococcus*

Clinical illness – meningitis or meningococcemia with headache, fever, stiff neck, chills, malaise, prostration and rash

Plus laboratory evidence – bacterial cultures of blood, cerebrospinal fluid (CSF), or other sterile site positive for *N. meningitidis*

Or – compatible clinical illness in a HCW who is epidemiologically linked to a case confirmed in the previous 7 days

2.2.4 *OH Work Practices to Manage HCWs Exposed to or Infected with Meningococcus*

2.2.4.1 HCWs Exposed to Meningococcus

OH should refer exposed HCWs for clinical management, which should include

- chemoprophylaxis given within 10 days after the most recent exposure[216] or as specified by provincial/territorial public health authorities[24]. **AII**

OH should not routinely culture specimens from close contacts[216]. **AIII**

Post-exposure immunization is not recommended[8,216]. **AIII**

There are no work restrictions for HCWs exposed to meningococcus.

OH should ensure that emergency responders are included in the identification of exposed HCWs and that the public health authorities are notified in a timely manner regarding postexposure management[19]. **AIII**

2.2.4.2 HCWs Colonized, Symptomatic or Infected with Meningococcus

OH should refer HCWs symptomatic or infected with meningococcus for confirmation of diagnosis and for clinical management; these should include

- laboratory investigation,
- antibiotics for treatment of infection[24,213,216]. **AII**

OH should not exclude HCWs colonized with *N. meningitidis* from work. **AIII**

OH should exclude HCWs who are symptomatic or infected with meningococcus until 24 hours after the start of effective therapy[4]. **AIII**

OH should not refer unexposed HCWs found to have nasopharyngeal colonization with *N. meningitidis* for prophylaxis or treatment[204], as the role of antibiotics in eliminating colonization is limited to those persons exposed to a case. **AIII**

OH should inform IC as soon as possible of a suspected or confirmed case of meningococcus. **AIII**

2.2.4.3 OH Management of Meningococcus Outbreak

OH should consider the possibility of an outbreak if more than one HCW on the same unit meet the criteria for diagnosis. **AIII**

OH should liaise with IC and public health authorities if an outbreak is suspected[216]. **AIII**

2.2.4.4 OH Reporting to Public Health Authorities of HCWs with Meningococcus

OH should report a case or a suspected or confirmed outbreak as soon as possible to public health authorities as required by legislation.

3. Education of HCWs about Prevention and Management of Exposure to or Infection with Meningococcus

OH should develop education specific to meningococcus according to the recommendations outlined in Section A-3 and should include the point that prophylaxis is required only for those who meet the definition of exposure. **AIII**

4. Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infection with Meningococcus

OH should refer to Section A-4 to develop an evaluation program specific to meningococcus that would include

- the number of HCWs receiving prophylaxis,
- the number of HCWs with preventable exposures. **AIII**

Mumps

1. Risk Assessment for Transmission of Mumps to HCWs

1.1 Clinical Significance of Mumps

Mumps is an acute viral disease caused by a paramyxovirus. It is characterized by fever, and swelling and tenderness of one or more salivary glands, especially the parotid gland. Neurologic involvement and orchitis may occur without salivary gland involvement. Infection during the first trimester of pregnancy may increase the rate of spontaneous abortion. There is no evidence that mumps during pregnancy causes congenital malformations[23].

1.2 Evidence of Exposure/Transmission of Mumps

About one-third of exposed, susceptible people have inapparent infections[23].

As a result of an increase in the incidence of measles, mumps and rubella among U.S. adults, a study to determine antibody prevalence among U.S. army recruits was carried out and the results published in 1991. The authors reported that as many as 16% to 18% of young adults may be susceptible to measles, mumps, and rubella[199]. The opportunity to ensure immunity to these viruses should not be overlooked[187].

Serologic studies show that more than 85% of people have had mumps infection in the absence of immunization by the time they are adults[23].

Since the introduction of the mumps vaccine in Canada, the incidence of clinical mumps has decreased by 90%[8].

Mumps transmission can be sustained among the few persons not protected by vaccination, as evidenced by outbreaks occurring in highly vaccinated populations[24].

Outbreaks of mumps have been reported in hospitals only infrequently[217-219] and may not be identifiable because of the relatively long incubation period in comparison to the short hospital stays of most patients[219].

Mumps poses a small but real risk to both patients and staff in hospital settings. In an outbreak (community and hospital or long-term care) in Tennessee in 1986-87, at least six HCWs were reported to have developed mumps after exposure to infectious patients. Personal Protective Equipment, e.g. masks, were not reportedly worn[219].

Recommendations

Compliance with the recommendations for the components of an OH program outlined in Section A–1-4 is required in addition to the following specific recommendations for mumps.

2. Risk Control Measures

2.1 Risk Control Measures to Prevent HCW Exposure to or Infection with Mumps

2.1.1 *Engineering Controls*

See Section A-2.1.1.

2.1.2 *Administrative Controls*

See Section A- 2.1.2.

2.1.3 *OH Work Practices*

OH should document HCW immune status at the preplacement examination[8]. **AIII**

OH should consider HCWs to be immune to mumps if they were born before 1970, or if they were born in or after 1970 and have evidence of one dose of live mumps-containing vaccine, physician-diagnosed mumps, or documentation of mumps IgG[8]. **AIII**

OH should immunize all susceptible HCWs with a single dose of live mumps-containing vaccine given as measles, mumps, rubella (MMR) unless there are contraindications[8,187,199,217,219]. **AII**

OH should ensure that HCWs who are susceptible do not work with patients suspected or confirmed to have mumps[8]. **AIII**

2.1.4 *Personal Protective Equipment*

OH should ensure that HCWs who are susceptible but who absolutely must be within 1 m of a patient for whom Droplet Precautions are in place for suspected or confirmed mumps are provided with a surgical/procedure mask[4]. **BIII**

2.2 Risk Control Measures to Manage HCWs Exposed to or Infected with Mumps

2.2.1 *Assessment of HCW Exposure to Mumps*

2.2.1.1 Method of Transmission of Mumps

Mumps is transmitted by direct and droplet contact of the oral or nasal mucous membranes of a susceptible person with infectious saliva.

2.2.1.2 Definition of Occupational Exposure to Mumps

OH should define exposure as direct or droplet contact of the oral or nasal mucous membranes of a susceptible HCW with infectious saliva during the 2 days before and up to 9 days after the onset of parotid swelling. **AIII**

2.2.2 *Assessment of Source of HCW Exposure*

In collaboration with IC, OH should confirm the diagnosis of the source and assess the potential for communicability at the time of HCW exposure. **AIII**

2.2.2.1 Communicability of Source

The incubation period is 12 to 25 days. The period of communicability is 2 days before to 9 days after the onset of parotid swelling[4].

2.2.3 *Criteria to Confirm the Diagnosis of Mumps*

Clinical illness – swelling of the salivary gland(s), fever, orchitis, meningitis

Plus laboratory evidence – IgM antibody positive for mumps; four-fold rise in mumps IgG antibody; viral culture of an appropriate clinical specimen positive for mumps

2.2.4 *OH Work Practices to Manage HCWs Exposed to or Infected with Mumps*

2.2.4.1 HCWs Exposed to Mumps

OH should determine the immune status of the HCW. If the immunity of the HCW is unknown, OH should test the HCW for the presence of antibody. **AIII**

OH should consider HCWs to be immune to mumps if they were born before 1970, or if they were born in or after 1970 and have evidence of one dose of live mumps-containing vaccine, physician-diagnosed mumps, or documentation of mumps IgG[8]. **AIII**

OH should consider mumps immunization given as MMR for susceptible HCWs if the HCW exposure did not result in clinical disease and there are no contraindications to immunization[24]. **AIII**

OH should exclude susceptible, exposed HCWs from work from the 10th day after their first exposure through the 26th day after their last exposure[4]. **AIII**

2.2.4.2 HCWs Symptomatic or Infected with Mumps

OH should refer HCWs who are symptomatic or infected with mumps for confirmation of diagnosis and for clinical management, which may include laboratory investigation. **AIII**

OH should exclude a HCW with mumps from work until 9 days after the onset of parotid swelling[4]. **AIII**

OH should inform IC as soon as possible of a case of suspected or confirmed mumps. **AIII**

2.2.4.3 OH Management of a Mumps Outbreak

OH should consider the possibility of an outbreak if more than one HCW or patient on the same unit meet the criteria for diagnosis. **AIII**

OH should liaise with IC and public health authorities if an outbreak is suspected. **AIII**

2.2.4.4 OH Reporting to Public Health Authorities of HCWs with Mumps

OH should report a case or a suspected or confirmed outbreak to public health authorities as required by legislation.

3. Education of HCWs about Prevention and Management of Exposure to or Infection with Mumps

OH should develop education specific to mumps according to the recommendations outlined in Section A-3. **AIII**

4. Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infection with Mumps

OH should refer to Section A-4 to develop an evaluation program for mumps, including

- rates of exposure and infections,
- time lost due to exposure and infections,
- cost of tracking exposures for a vaccine preventable disease. **AIII**

Parvovirus B 19

1. Risk Assessment for Transmission of Parvovirus B 19 to HCWs

1.1 Clinical Significance of Parvovirus B 19

Infection with parvovirus B 19 usually manifests as erythema infectiosum in children (fifth disease), which is characterized by mild systemic symptoms, including fever, and frequently a distinctive rash. Many cases are asymptomatic, and symptomatic cases are usually self-limited. Over one-half of adults have evidence of past infection and are probably not susceptible to reinfection. Parvovirus B 19 is also the primary infectious etiologic agent of transient aplastic crisis in patients with chronic hemolytic anemias[24].

Several groups are at risk for serious disease:

1) patients with chronic hemolytic anemia who may develop aplastic crisis during acute infection,

2) non-immune pregnant women in whom the virus can cause fetal hydrops and death,

3) immunodeficient individuals with defective antibody production — including those with certain congenital immunodeficiencies, AIDS, and some hematologic malignancies — who may develop chronic anemia[220].

The risk of fetal death is between 2% and 6%, the greatest risk occurring when maternal infection is in the first half of pregnancy[24].

Because of the high prevalence of immunity to parvovirus B 19, the low incidence of ill effects on the fetus, and the fact that exclusion can only reduce but not eliminate the risk of exposure, routine exclusion of pregnant women from the workplace where erythema infectiosum is occurring is not recommended[24,221].

Pregnant women who were exposed to an individual who was in the incubation period of erythema infectiosum or in aplastic crisis should have the relatively low potential risk explained to them and the option of serologic testing offered[24,221].

1.2 Evidence of Exposure/Transmission of Parvovirus B 19

Parvovirus B 19 transmission to HCWs has been suggested in numerous reports[222-227], but none included control groups of adequate size. All but one investigation occurred following

the recognition of an outbreak of parvovirus B 19 disease among HCWs[227]. When control groups were used, an increased risk of transmission of parvovirus B 19 to HCWs was not identified, despite prolonged exposures to patients with transient aplastic crisis who were not placed in contact isolation[227].

In a study carried out to evaluate the risk of transmission of parvovirus B 19 to HCWs after exposure to patients with transient aplastic crisis, the authors were unable to identify any increased risk of nosocomial transmission of parvovirus B 19[228].

Recommendations

Compliance with the recommendations for the components of an OH program outlined in Section A–1-4 is required in addition to the following specific recommendations for parvovirus B 19.

2. Risk Control Measures

2.1 Risk Control Measures to Prevent HCW Exposure to or Infection with Parvovirus B 19

2.1.1 *Engineering Controls*

See Section A- 2.1.1.

2.1.2 *Administrative Controls*

See Section A-2.1.2.

2.1.3 *OH Work Practices to Prevent HCW Exposure to or Infection with Parvovirus B 19*

OH should not routinely exclude pregnant HCWs from caring for patients with parvovirus B19[24,220,221,228], because most persons are not infectious by the time of rash onset, when infection is first recognized[220]. **AII**

OH should educate pregnant HCWs on the potential risks to the fetus from parvovirus B19 infection and about the preventive measures that may reduce these risks[24,220,221]. **AIII**

2.1.4 *Personal Protective Equipment*

OH should advise HCWs to wear a surgical/procedure mask if within 1 m of a patient for whom Droplet Precautions are in place for suspected or confirmed transient parvovirus-related aplastic or erythrocyte crisis[4]. **BIII**

2.2 Risk Control Measures to Manage HCWs Exposed to or Infected with Parvovirus B 19

2.2.1 *Assessment of HCW Exposure to Parvovirus B 19*

2.2.1.1 Method of Transmission of Parvovirus B 19

Parvovirus B 19 is transmitted by droplet and direct contact of the oral or nasal mucous membranes with the respiratory secretions of an infectious individual.

2.2.1.2 Definition of Occupational Exposure to Parvovirus B 19

OH should define exposure as a susceptible HCW having direct or droplet contact of oral or nasal mucous membranes with infectious respiratory secretions. **AIII**

2.2.2 *Assessment of Source of HCW Exposure*

In collaboration with IC, OH should confirm the diagnosis of the source and assess the potential for communicability at the time of HCW exposure. **AIII**

2.2.2.1 Communicability of Source

The incubation period of parvovirus B 19 is 4 to 21 days. The period of communicability during transient aplastic or erythrocyte crisis is 7 days. Patients with fifth disease are no longer infectious by the time the rash appears. Immunocompromised patients with chronic infection may shed the virus for a prolonged period[4]. **AIII**

2.2.3 *Criteria to Confirm the Diagnosis of Parvovirus B 19*

Clinical illness – mild systemic symptoms of fever, malaise, myalgia, and headache followed 7 to 10 days later by a distinctive rash of red cheeks, circumoral pallor, and a symmetrical maculopapular, lacelike rash on arms, trunk, buttocks, and thighs, which fluctuates in intensity with environmental change

Plus laboratory evidence – IgM antibody positive for parvovirus B 19 or four-fold rise in parvovirus B 19 IgG antibody

Or – compatible clinical illness in a HCW who is epidemiologically linked to a case confirmed in the previous 3 weeks

2.2.4 *OH Work Practices to Manage HCWs Exposed to or Infected with Parvovirus B 19*

2.2.4.1 HCWs Exposed to Parvovirus B 19

OH should refer pregnant HCWs exposed to children in the incubation period of erythema infectiosum or who were in aplastic crisis caused by

parvovirus B 19 to their physicians for clinical management, which may include laboratory investigation[24]. **AIII**

There may be transmission of parvovirus B 19 from HCWs who are incubating infection to susceptible individuals. However, currently there are no data on the benefit of modifications to work practices or work restrictions for susceptible HCWs exposed to parvovirus B 19. Although there is no consensus on the issue, OH may want to consider excluding exposed HCWs during the incubation period from caring for antibody deficient, immunocompromised patients e.g. those undergoing bone marrow transplantation, or patients with some hematologic malignancies, congenital agammaglobulinemia, advanced HIV disease, or chronic hemolytic anemia, unless serologic tests show that the HCW is immune to parvovirus B 19[220,221]. **AIII**

2.2.4.2 HCWs Symptomatic or Infected with Parvovirus B 19

OH should refer pregnant HCWs who are symptomatic or infected with parvovirus B 19 to their physicians for confirmation of diagnosis and for clinical management, which may include laboratory investigation. **AIII**

There are no modifications to work practices or work restrictions for HCWs symptomatic or infected with parvovirus B 19.

2.2.4.3 OH Management of Parvovirus B 19 Outbreak

OH should consider the possibility of an outbreak if more than one HCW on the same unit meet the criteria for diagnosis. **AIII**

OH should liaise with IC and public health authorities if an outbreak is suspected. **AIII**

In consultation with IC, OH should consider testing exposed HCWs for immunity to parvovirus B 19. **AIII**

In consultation with IC, OH should consider modifications to work practices or work restrictions for exposed, susceptible HCWs caring for high-risk patients, e.g. those with antibody deficiency due to bone marrow transplantation, some hematologic malignancies, congenital agammaglobulinemia, advanced HIV disease, or chronic hemolytic anemia. **AIII**

2.2.4.4 OH Reporting to Public Health Authorities of HCWs with Parvovirus B 19

There is no reporting requirement for a single case; OH should report a suspected or confirmed outbreak to public health authorities as required by legislation.

3. Education of HCWs about Prevention and Management of Exposure to or Infection with Parvovirus B 19

OH should design education specific to parvovirus B 19 according to the recommendations outlined in Section A-3, to include

- minimal risk of transmission to HCWs,
- high rate of immunity,
- when there are respiratory secretions, the recommendation for handwashing and good hygienic practices as practical and effective measures to decrease parvovirus B19 transmission[220],
- the possibility of transmission during the incubation period of erythema infectiosum with the proviso that once the rash develops the patient is no longer infectious,
- the relatively low potential risk to the fetus in the case of maternal parvovirus infection, i.e. in most cases of parvovirus B 19 infection during pregnancy, the fetus has not been adversely affected. **AIII**

4. Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infection with Parvovirus B 19

OH should refer to Section A-4 to develop an evaluation program specific to parvovirus B 19. **AIII**

Pediculosis (Lice)

1. Risk Assessment for Transmission of Pediculosis to HCWs

1.1 Clinical Significance of Pediculosis

Pediculosis is an infestation with any of three species of lice: *Pediculus humanus capitis*, *Pediculus humanus corporis*, and *Phthirus pubis,* causing human head lice, body lice, and pubic/crab lice respectively. All three infest humans only and are most often localized to one part of the body[229].

Head lice infestation in child care settings and in schools is common[24].

1.2 Evidence of Exposure/Transmission of Pediculosis

There is negligible risk of transmission of body lice or pubic/crab lice in a hospital setting, and there is a low risk of transmission of head lice unless close, head-to-head contact between HCW and patient occurs[229].

Recommendations

Compliance with the recommendations for the components of an OH program outlined in Section A–1-4 is required in addition to the following specific recommendations for pediculosis.

2. Risk Control Measures

2.1 Risk Control Measures to Prevent HCW Exposure to or Infestation with Pediculosis

2.1.1 *Engineering Controls*

Administration should ensure that there is consideration of plastic-covered pillows and protected chairs in communal areas, e.g. psychiatry units, community health centres, physiotherapy and emergency departments. **AIII**

2.1.2 *Administrative Controls*

See Section A-2.1.2.

2.1.3 *OH Work Practices*

See Section A-2.1.3.

2.1.4 *Personal Protective Equipment*

OH should advise HCWs to wear gloves when in direct contact with a patient infested with lice[4]. **AII**

2.2 Risk Control Measures to Manage HCWs Exposed to or Infested with Pediculosis

2.2.1 *Assessment of HCW Exposure to Pediculosis*

2.2.1.1 Method of Transmission of Pediculosis

Head lice are transmitted by direct head-to-head contact with an infested individual or indirectly by objects used by them, especially shared clothing and headgear. Body lice are transmitted by direct skin-to-skin contact or exchange of infested clothing or bedding. Transmission of crab lice occurs by direct skin-to-skin transfer.

2.2.1.2 Definition of Occupational Exposure to Pediculosis

OH should define exposure to head lice as direct or indirect hair-to-hair contact with a patient infested with head lice prior to 24 hours of effective treatment. Body lice exposure is defined as direct skin-to-skin contact or skin contact with the clothing or bedding of an infested person prior to 24 hours of effective treatment. Crab lice transmission is not applicable in an OH setting. **AIII**

2.2.2 *Assessment of Source of HCW Exposure*

In collaboration with IC, OH should confirm the diagnosis of the source and assess the potential for communicability at the time of HCW exposure. **AIII**

2.2.2.1 Communicability of Source

The incubation period is 6 to 10 days. The period of communicability continues until 24 hours after effective treatment of lice and ova[4].

2.2.3 *Criteria to Confirm the Diagnosis of Pediculosis*

Clinical illness – intense itching of affected body site and the presence of eggs (nits) on the hair shaft or occasionally visible lice

Without laboratory evidence.

2.2.4 *OH Work Practices to Manage HCWs Exposed to or Infested with Pediculosis*

2.2.4.1 HCWs Exposed to Pediculosis

There are no modifications to work practices or work restrictions for HCWs exposed to pediculosis[24,33,230].

2.2.4.2 HCWs Symptomatic or Infested with Pediculosis

OH should refer HCWs with symptoms or infestation with lice for confirmation of diagnosis and for clinical management, which should include provision of effective pediculocide[24,33,141]. **BIII**

OH should exclude HCWs infested with pediculosis until completion of effective therapy, i.e. usually 24 hours after one application of appropriately applied pediculocide[33] , and re-evaluation prior to return to work[230]. **AIII**

OH should advise HCWs that exposed family members and intimate contacts should seek medical evaluation from a public health nurse, community health centre, or physician regarding evaluation of risk, prophylaxis, diagnosis, and/or treatment. **BIII**

OH should advise HCWs to return for assessment for fitness to work. **AIII**

2.2.4.3 OH Management of Pediculosis Outbreak

OH should consider the possibility of an outbreak if more than one HCW on the same unit meet the criteria for diagnosis. **AIII**

OH should liaise with IC and public health authorities if an outbreak is suspected. **AIII**

OH may, in consultation with IC, modify work restrictions as necessary in outbreaks. **AIII**

2.2.4.4 OH Reporting to Public Health Authorities of HCWs with Pediculosis

OH should report a suspected or confirmed outbreak to public health authorities as required by legislation.

3. Education of HCWs about Prevention and Management of Exposure to or Infestation with Pediculosis

OH should develop education specific to pediculosis according to the recommendations outlined in Section A-3, to include

- need for symptomatic family members and intimate contacts of HCWs to seek medical evaluation,

- recommendations for prophylaxis,
- importance of following treatment product instructions carefully,
- need for individuals to bathe and change their clothing after treatment[24],
- importance of laundry handling, i.e. hot water washing and drying at hot cycles (temperatures exceeding 53.5° C or 128.3° F for 5 minutes are lethal to lice and eggs), or dry cleaning of infested bedding or clothing, or storage in a sealed plastic bag for 10 days to destroy eggs and lice[24],
- importance of soaking brushes and combs in pediculocide or hot water[24],
- recommendation that disinfecting furniture is unnecessary; but vacuuming can be done[24],
- consideration of pillow protection and vinyl-type rather than cloth upholstery for chairs in communal areas, e.g. psychiatry units, emergency and physiotherapy departments, and community health centres,
- instruction to not share hats, headphones, combs, brushes, hair accessories,
- need to return for assessment before return to work,
- the possible need for retreatment after an interval of 7 to 10 days if eggs survive[23,24], given that no treatment can be guaranteed to be completely effective. **AIII**

4. Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infestation with Pediculosis

OH should refer to Section A-4 to develop an evaluation program specific to pediculosis, including

- the rate of infestation,
- the number of HCWs requiring treatment. **AIII**

Pertussis (Whooping Cough)

1. Risk Assessment for Transmission of Pertussis to HCWs

1.1 *Clinical Significance of Pertussis*

Pertussis (whooping cough) is a highly communicable infection of the respiratory tract caused by *Bordetella pertussis*. Pertussis can affect individuals of any age, but the severity is greatest in young infants[231]. Pertussis in young infants may be complicated by pneumonia, seizures and encephalopathy. The mortality rate among children < 1 month of age is 1.3%[24].

Parapertussis (caused by *Bordetella parapertussis*) is a similar but usually milder disease. Differentiation between pertussis and parapertussis is based on culture of the organism[23].

1.2 *Evidence of Exposure/Transmission of Pertussis*

The incidence of pertussis in Canada over the past 40 years has decreased by over 90% as a result of immunization. The annual number of reported cases has ranged from 1,000 to 10,000 over the past 10 years, although reporting may be incomplete[231].

Most adults are susceptible to pertussis because immunization-induced immunity from the older vaccine disappears within 12 years after the last immunization[232].

Cases and outbreaks continue to occur in Canada because of incomplete immunization coverage, the need for multiple doses of vaccine to achieve protection, the less than 100% efficacy of the vaccine, waning vaccine-induced immunity in those > 6 years of age, and continued circulation of the organism[233].

Acellular pertussis vaccines have better safety and efficacy profiles than whole cell vaccines; whole cell vaccines are no longer recommended in Canada[8].

Currently, there are insufficient data to recommend more than one dose of acellular pertussis vaccine for adults. In the future, booster doses with the new, acellular vaccine might represent the safest, least expensive strategy to reduce pertussis reservoirs among susceptible adults who work closely with children in hospitals[8,234,235].

Health care facilities have reported large outbreaks of pertussis. The reasons are multifactorial, including failure to recognize and isolate infected infants and children, lack of highly sensitive, rapid diagnostic tools, failure to appreciate that immunity following immunization

wanes with time, failure to diagnose, failure to institute control measures rapidly, and failure to recognize and treat disease in HCWs[236].

Transmission to HCWs whose immunization has waned has been reported[237-239], and transmission has occurred because when HCWs have been reported a diagnosis of pertussis in adults with paroxysmal cough was unlikely to be considered[238].

HCWs may be exposed to and infected with pertussis much more frequently than reported, as demonstrated by serologic studies[234,237,240,241].

Recommendations

Compliance with the recommendations for the components of an OH program outlined in Section A–1-4 is required in addition to the following specific recommendations for pertussis.

2. Risk Control Measures

2.1 Risk Control Measures to Prevent HCW Exposure to or Infection with Pertussis

2.1.1 *Engineering Controls*

See Section A-2.1.1.

2.1.2 *Administrative Controls*

See Section A-2.1.2.

2.1.3 *OH Work Practices*

OH should document the immune status of HCWs at the preplacement examination[8,233,236]. **AIII**

OH should consider all HCWs to be susceptible to pertussis, since immunity wanes[232,233]. **AIII**

There are no recommendations for immunization with whole cell vaccine for persons > 7 years because adverse reactions may be more common and disease is typically less severe than in young children. Study of the new acellular vaccine regarding the safety, immunogenicity, and efficacy in adults is in progress. Although acellular vaccine, which includes tetanus and diphtheria with the pertussis, is now licensed for adults and NACI recommends that one dose (dTap) can be used instead of tetanus-diphtheria (Td) vaccine in adults who have to be protected against diphtheria and tetanus, safety data are lacking for more than one dose. Until the use in adults is clarified and guidelines are published regarding repeated doses, there is no NACI recommendation for universal use or as part of repeated tetanus-diphtheria boosters at the time of this publication[8,235]. **C**

2.1.4 *Personal Protective Equipment*

OH should advise HCWs to wear a surgical/procedure mask when within 1 m of a patient for whom Droplet Precautions are in place for suspected or confirmed pertussis[4]. **BIII**

2.2 Risk Control Measures to Manage HCWs Exposed to or Infected with Pertussis

2.2.1 *Assessment of HCW Exposure to Pertussis*

2.2.1.1 Method of Transmission of Pertussis

Pertussis is transmitted by droplet contact of the oral or nasal mucous membranes with the respiratory secretions from an infected individual.

2.2.1.2 Definition of Occupational Exposure to Pertussis

OH should define exposure as droplet contact of oral or nasal mucous membranes with infectious respiratory secretions, face-to-face contact longer than 5 minutes with an infectious individual, or sharing the same confined air space, i.e. being within 1 m of an infectious individual, for longer than 1 hour[233]. **AIII**

2.2.2 *Assessment of Source of HCW Exposure*

In collaboration with IC, OH should confirm the diagnosis of the source and assess the potential for communicability at the time of HCW exposure. **AIII**

2.2.2.1 Communicability of Source

The incubation period is 6 to 20 days[4]. The period of communicability is from 1 to 2 weeks before the onset of paroxysmal cough until 3 weeks after the onset of cough if not treated, or 5 days after initiation of effective antibiotic therapy[4,236].

2.2.3 *Criteria to Confirm the Diagnosis of Pertussis*

Clinical illness – respiratory tract symptoms progressing to severe paroxysms of cough, often with a characteristic respiratory whoop, followed by vomiting; apnea and absence of whoop is common in infants

Plus laboratory evidence – bacterial culture of the nasopharynx positive for *B. pertussis* or PCR assay of nasopharyngeal specimen positive for *B. pertussis*

2.2.4 *OH Work Practices to Manage HCWs Exposed to or Infected with Pertussis*

2.2.4.1 HCWs Exposed to Pertussis

OH should consider all HCWs to be susceptible to pertussis because immunity wanes[232,233]. **AIII**

OH should refer exposed HCWs for clinical management, which should include laboratory investigation and chemoprophylaxis[233,236]. **AIII**

OH should not impose work restrictions on exposed HCWs who are taking prophylactic antibiotics[33,230,233,236]. **AIII**

OH should exclude exposed HCWs from work who refuse or are unable to take prophylaxis until 20 days after their last exposure[24]. **AIII**

OH should consider discontinuing prophylactic antibiotics for exposed HCWs if the laboratory investigation of the source is negative for *B. pertussis*. **BIII**

2.2.4.2 HCWs Symptomatic or Infected with Pertussis

OH should refer HCWs who are symptomatic or infected with pertussis for confirmation of diagnosis and for clinical management, which should include laboratory investigation and antibiotic therapy[236]. **AIII**

OH should exclude HCWs who are symptomatic or infected with pertussis until after 5 days of effective therapy[24,236] or from the beginning of the catarrhal stage through the 3rd week after the onset of paroxysms, if untreated[4,24,233,236]. **AIII**

OH should inform IC as soon as possible of a suspected or confirmed case of pertussis. **AIII**

2.2.4.3 OH Management of Pertussis Outbreak

OH should consider the possibility of an outbreak if more than one HCW on the same unit meet the criteria of diagnosis. **AIII**

OH should liaise with IC and public health authorities if an outbreak is suspected[233]. **AIII**

In consultation with IC, OH may modify work restrictions as necessary in outbreaks. **AIII**

2.2.4.4 OH Reporting to Public Health Authorities of HCWs with Pertussis

OH should report a case and a suspected or confirmed outbreak to public health authorities as required by legislation.

3. Education of HCWs about Prevention and Management of Exposure to or Infection with Pertussis

OH should develop education specific to pertussis according to the recommendations outlined in Section A-3, to include information related to the following:

- waning immunity,
- the fact that pertussis can occur in adults and adults can transmit to infants,
- the lack of definitive data for booster dose recommendations. **AIII**

4. Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infection with Pertussis

OH should refer to Section A-4 to develop an evaluation program specific to pertussis, including

- rates of exposures and infections,
- the number of HCWs that received prophylaxis,
- time lost due to exposures and infections. **AIII**

Rubella (German Measles)

1. Risk Assessment for Transmission of Rubella to HCWs

1.1 Clinical Significance of Rubella

Rubella (German measles) is an acute exanthematous viral infection that affects children and adults[33] and may pose serious consequences to the fetus of a susceptible pregnant woman.

Congenital rubella syndrome occurs in up to 90% of infants born to women who acquire rubella during the first trimester of pregnancy. Fetuses infected early are at greatest risk of intrauterine death, spontaneous abortion, and congenital malformations of major organ systems[23].

1.2 Evidence of Exposure/Transmission of Rubella

Rubella outbreaks in health care facilities are of particular concern because of potential spread to susceptible pregnant women, both HCWs and patients[242].

Medical students have been found to be important sources of transmission in measles and rubella outbreaks[195].

Because of an increase in the incidence of measles, mumps and rubella among U.S. adults, a study to determine antibody prevalence among U.S. army recruits was completed. The authors reported that as many as 16% to 18% of young adults may be susceptible to measles, mumps, and rubella[199]. The opportunity to ensure immunity to these viruses should not be overlooked[187].

Transmission of rubella in health care facilities involving male or female HCWs and patients[242-245], and susceptible pregnant women[243,246-248] has been reported.

In one report, a nurse known to be susceptible was assigned to care for an infant with congenital rubella syndrome during a nursing shortage, and developed clinical disease[245].

A male obstetrics-gynecology house officer infected with rubella exposed 170 personnel and 11 patients. His pre-employment history and physical examination were negative and there was no note of prior rubella infection or immunization. No rubella titre had been measured[245].

Following a work-related exposure, a nurse working in a hospital-based obstetric clinic was infected and exposed 151 patients and 44 HCWs to clinical disease[249].

A rubella outbreak involving HCWs exposed 200 pregnant women who were < 16 weeks pregnant. HCWs experienced mild symptoms and continued to work while infectious, resulting in a delay in diagnosis[246].

Finally, a hospital outbreak of rubella involving 47 HCWs resulted in the termination of one pregnancy and loss of 475 workdays[248].

Recommendations

Compliance with the recommendations for the components of an OH program outlined in Section A–1-4 is required in addition to the following specific recommendations for rubella.

2. Risk Control Measures

2.1 Risk Control Measures to Prevent HCW Exposure to or Infection with Rubella

2.1.1 *Engineering Controls*

See Section A-2.1.1.

2.1.2 *Administrative Controls*

See Section A-2.1.2.

2.1.3 *OH Work Practices*

OH should document the HCW immune status at the preplacement examination[8]. **AIII**

OH should consider HCWs to be immune to rubella when there is evidence of one dose of live rubella-containing vaccine or documentation of rubella IgG[8]. **AIII**

NACI recommends immunization *only* for female HCWs of childbearing age without documented immunity and susceptible HCWs of either sex who may, through face-to-face contact, expose pregnant women to rubella. *However*, all HCWs may expose and transmit rubella to pregnant females. *Therefore, irrespective of NACI recommendations,* OH should immunize all susceptible HCWs with a single dose of live rubella-containing vaccine given as measles, mumps and rubella (MMR) vaccine, unless there are contraindications[242-245,247,249]. **AII**

OH should not vaccinate susceptible female HCWs during pregnancy because there is a theoretic risk of the rubella vaccine causing adverse consequences to the fetus[8]. OH should offer vaccine postpartum if it is not provided by the physicians after delivery. **BIII**

OH should advise female HCWs of child-bearing age to avoid pregnancy for 1 month after MMR immunization[8]. **AIII**

OH should inform the susceptible HCW and his or her manager of the HCW's fitness to work with patients suspected or confirmed to have rubella. **AIII**

OH should ensure that HCWs who are susceptible do not work with patients suspected or confirmed to have rubella[30,242]. **AII**

2.1.4 *Personal Protective Equipment*

OH should ensure that HCWs who are susceptible but who absolutely must be within 1 m of a patient for whom Droplet Precautions are in place for suspected or confirmed rubella are provided with a surgical/procedure mask[4]. **BIII**

OH should advise HCWs who care for patients with suspected or confirmed congenital rubella to wear gloves when entering the single room or designated bedspace in a shared room of a patient for whom Contact Precautions are in place for suspected or confirmed congenital rubella, and to wear a gown if direct contact with the individual or environmental surfaces is likely[4]. **BII**

2.2 Risk Control Measures to Manage HCWs Exposed to or Infected with Rubella

2.2.1 *Assessment of HCW Exposure to Rubella*

2.2.1.1 Method of Transmission of Rubella

Rubella is transmitted by direct and droplet contact of the oral or nasal mucous membranes with respiratory secretions from an infected individual, or direct and indirect contact of the oral or nasal mucous membranes with urine from an infant with congenital rubella syndrome.

2.2.1.2 Definition of Occupational Exposure to Rubella

OH should define exposure to rubella as direct or droplet contact of oral or nasal mucous membranes of a susceptible HCW with infectious respiratory secretions during the period from 7 days before onset of symptoms to 7 days after symptoms appear. **AIII**

OH should define exposure to rubella associated with congenital rubella syndrome as droplet, direct, or indirect contact of oral or nasal mucous membranes of a susceptible HCW with the respiratory secretions or urine of an infant with congenital rubella syndrome. **AIII**

2.2.2 *Assessment of Source of HCW Exposure*

In collaboration with IC, OH should confirm the diagnosis of the source and assess the potential for communicability at the time of HCW exposure. **AIII**

2.2.2.1 Communicability of Source

The incubation period is 14 to 21 days. The period of communicability is from 7 days before to 7 days after the onset of rash[4]. Infants with congenital rubella may shed virus and therefore remain infectious for months after birth[23].

2.2.3 *Criteria to Confirm the Diagnosis of Rubella*

Clinical illness – generalized erythematous, maculopapular rash, lymphadenopathy, slight fever, transient polyarthralgia, polyarthritis

Plus laboratory evidence – IgM antibody positive for rubella; four-fold rise in rubella IgG antibody; viral culture of an appropriate clinical specimen positive for rubella

2.2.4 *OH Work Practices to Manage HCWs Exposed to or Infected with Rubella*

2.2.4.1 HCWs Exposed to Rubella

OH should determine the immune status of the exposed HCW. If it is unknown or uncertain, test for IgG antibody. **AIII**

OH should consider HCWs to be immune to rubella when there is evidence of one dose of live rubella-containing vaccine or documentation of rubella IgG[8]. **AIII**

OH should refer pregnant, susceptible, exposed HCWs to their physicians for clinical management. **BIII**

OH should refer exposed, susceptible HCWs for clinical management, which should include

- immunization (except if contraindicated) if exposure did not result in infection in order to provide protection in the event of future exposures. Live virus vaccine given after exposure does not prevent illness[8];
- administration of immune globulin to exposed HCWs within 48 hours of exposure, in order to attempt to modify or suppress symptoms, even though immune globulin is not fully effective in preventing infection, including congenital infection[8]. **AIII**

OH should exclude susceptible exposed HCWs from work from the 7th day after their first exposure through the 21st day after their last exposure[4]. **AIII**

2.2.4.2 HCWs Symptomatic or Infected with Rubella

OH should refer HCWs symptomatic or infected with rubella for confirmation of diagnosis and for clinical management, which should include laboratory investigation and management of complications, e.g. arthritis. **AIII**

OH should exclude HCWs symptomatic or infected with rubella from work until 7 days after the onset of rash[4]. **AIII**

OH should inform IC as soon as possible of a suspected or confirmed case of rubella. **AIII**

2.2.4.3 OH Management of Rubella Outbreak

OH should consider the possibility of an outbreak if more than one HCW on the same unit meet the criteria for diagnosis. **AIII**

OH should liaise with IC and public health authorities if an outbreak is suspected. **AIII**

2.2.4.4 OH Reporting to Public Health Authorities of HCWs with Rubella

OH should report a case or a suspected or confirmed outbreak to public health authorities as required by legislation.

3. Education of HCWs about Prevention and Management of Exposure to or Infection with Rubella

OH should design education specific to rubella according to the recommendations outlined in Section A-3. The information should include the fact that vaccine should not be administered during or until 1 month after pregnancy[8]. **AIII**

4. Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infection with Rubella

OH should refer to Section A-4 to develop an evaluation program specific to rubella, including

- rates of exposures and infections,
- time lost due to exposure and infections,
- cost of tracking exposures and infections for a vaccine preventable disease. **AIII**

Salmonella typhi

Note: Please refer to the section on gastroenteric infections in Part II, Grouped Diseases/Infections, page 147 for recommendations on salmonella infections other than *Salmonella typhi* (*S. typhi*).

1. Risk Assessment for Transmission of *S. typhi* to HCWs

1.1 Clinical Significance of *S. typhi*

S. typhi causes a systemic disease characterized by fever, constitutional symptoms, splenomegaly, and abdominal pain, and is associated with foreign travel. *Salmonella paratyphi* causes similar clinical symptoms but tends to be milder[23].

About 10% of patients with untreated typhoid fever will continue to have fecal colonization with the organism at 3 months after the onset of symptoms, and 2% to 5% become permanent fecal carriers[23].

1.2 Evidence of Exposure/Transmission of *S. typhi*

In the U.S., cases of *S. typhi* (typhoid fever) are usually acquired during foreign travel, i.e. to areas that lack safe food or drinking water, or by consumption of food contaminated by a chronic carrier[24].

Recommendations

Compliance with the recommendations for the components of an OH program outlined in Section A–1-4 is required in addition to the following recommendations specific to S. typhi.

2. Risk Control Measures

2.1 Risk Control Measures to prevent HCW Exposure to or Infection with *S. typhi*

2.1.1 *Engineering Controls*

See Section A-2.1.1.

2.1.2 *Administrative Controls*

See Section A-2.1.2.

2.1.3 *OH Work Practices*

There are no recommendations for routine immunization[8]. **AIII**

OH should consider immunization of laboratory workers in specialized reference or research facilities who frequently handle cultures of *S. typhi*[8]. **AIII**

2.1.4 *Personal Protective Equipment*

OH should advise HCWs to wear gloves when entering the single room or designated bedspace in a shared room of a pediatric patient for whom Contact Precautions are in place for suspected or confirmed *S. typhi,* and to wear gowns if direct contact with the patient or environmental surfaces is likely[4]. Contact Precautions may be required for incontinent adults if feces cannot be contained or for adults with poor hygiene who contaminate their environment[4]. **BII**

2.2 Risk Control Measures to Manage HCWs Exposed to or Infected with *S. typhi*

2.2.1 *Assessment of HCW Exposure to S. typhi*

2.2.1.1 Method of Transmission of *S. typhi*

S. typhi is transmitted by ingestion of food or water that has been contaminated with infectious feces or urine, or by direct or indirect ingestion of infectious feces or urine.

2.2.1.2 Definition of Occupational Exposure to *S. typhi*

OH should define exposure as a susceptible HCW having direct or indirect oral contact with infectious feces; exposure may also occur with ingestion of contaminated food or water. **AIII**

2.2.2 *Assessment of Source of HCW Exposure*

In collaboration with IC, OH should confirm the diagnosis of the source and assess the potential for communicability at the time of HCW exposure. **AIII**

2.2.2.1 Communicability of Source

The incubation period is 3 to 60 days[4]. The period of communicability continues as long as the bacilli appear in excreta, usually from the first week throughout convalescence, but for variable durations thereafter. About 10% of untreated patients with typhoid fever will discharge bacilli for about 3 months after onset of symptoms, and 2% to 5% become permanent carriers[23].

2.2.3 *Criteria to Confirm the Diagnosis of S. typhi*

Clinical illness – gradual onset of fever, headache, malaise, anorexia, lethargy, abdominal pain, tenderness, hepatomegaly, splenomegaly, and rose spots and/or

changes in mental status. Constipation may occur early, and diarrhea may develop later or not at all

Plus laboratory evidence – bacterial culture of appropriate clinical specimen positive for *S. typhi*

2.2.4 *OH Work Practices to Manage HCWs Exposed to or Infected with S. typhi*

2.2.4.1 HCWs Exposed to *S. typhi*

OH should refer exposed HCWs for clinical management, which may include laboratory investigation. **AIII**

There are no work restrictions for HCWs exposed to *S. typhi*.

2.2.4.2 HCWs Who Are Carriers of or Infected with *S. typhi*

OH should refer HCWs who are carriers of or infected with *S. typhi* for confirmation of diagnosis and for clinical management, which may include laboratory investigation and antibiotic therapy. **AIII**

OH should exclude HCWs with acute *S. typhi* infection from contact with patients and their environment and from food handling until stools are negative or as specified by public health authorities. **AIII**

OH should exclude HCWs determined to be carriers of *S. typhi* until they have been assessed for fitness to work. **AIII**

OH should inform IC as soon as possible of a suspected or confirmed case. **AIII**

2.2.4.3 OH Management of *S. typhi* Outbreak

OH should consider the possibility of an outbreak if more than one HCW on the same unit meet the criteria for diagnosis. **AIII**

OH should liaise with IC and public health authorities if an outbreak is suspected. **AIII**

2.2.4.4 OH Reporting to Public Health Authorities of HCWs with *S. typhi*

OH should report a case and a suspected or confirmed outbreak to public health authorities as required by legislation.

3. Education of HCWs about Prevention and Management of Exposure to or Infection with *S. typhi*

OH should design education specific to *S. typhi* according to the recommendations outlined in Section A-3, to include

- the fact that *S. typhi* is uncommon; usually the cases identified are chronic carriers who became infected by other chronic carriers or are a result of foreign travel to areas that lack safe food or drinking water,
- safe food handling practices,
- the case/carrier state,
- the difference between *S. typhi* and other salmonella strains. **AIII**

4. Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infection with *S. typhi*

OH should refer to Section A-4 to develop an evaluation program specific to *S. typhi,* including

- rates of exposures and infections,
- time lost due to infections. **AIII**

Scabies (*Typical* and *Norwegian*)

1. Risk Assessment for Transmission of Scabies to HCWs

1.1 Clinical Significance of Scabies

Scabies is a pruritic skin disease caused by infestation with the mite *Sarcoptes scabiei,* subspecies *hominis*[24].

Norwegian scabies, also known as crusted or keratotic scabies, is an uncommon form of infestation characterized by intense infestation and widespread crusted hyperkeratotic lesions. It usually occurs in debilitated, developmentally disabled, or immunologically impaired persons[24,250]. When transmitted to HCWs it manifests as *typical* scabies[250,251].

1.2 Evidence of Exposure/Transmission of Scabies

The risk of a scabies epidemic is much higher when the index case has *Norwegian* as opposed to *typical* scabies. Individuals with *Norwegian* scabies have hundreds of thousands of mites compared with those with *typical* scabies, who have about 20 to 50 mites per individual[250-253].

Minimal contact with *Norwegian* scabies can result in transmission because of the large number of mites in the exfoliating skin scales[24].

Norwegian or *typical* scabies can be transmitted as long as the patient remains infested and untreated, including the interval before symptoms develop[24].

Outbreak recognition may be delayed by the 4 to 6 week incubation period. During the incubation period asymptomatic case contacts may be actively and unknowingly transmitting mites[229].

Additional exposure and increased transmission as a result of misdiagnosis and therapeutic delay has been reported[229,252,254].

Outbreaks of scabies (*typical* and *Norwegian*) affecting HCWs have been reported in hospitals, extended care, and long-term care facilities[253-260].

A hospital outbreak traced to a case of *Norwegian* scabies resulted in symptomatic cases in 45 staff and 32 patients. Over 500 staff and 228 asymptomatic inpatient contacts required prophylaxis. There were recurrences in seven HCWs due variously to re-exposure to infected

patients (3) or affected family members (2), incomplete treatment (1), and incorrect application of medication (1). It took 4 months to contain the outbreak[257].

A sustained outbreak of *Norwegian* scabies from an index case at an extended care setting resulted in the infestation of 49% of the nurses (27/55). Individuals may harbour mites in their skin for several days before the onset of symptoms, and this occult carriage plays a role in scabies transmission[254].

Recommendations

Compliance with the recommendations for the components of an OH program outlined in Section A–1-4 is required in addition to the following specific recommendations for typical or Norwegian scabies.

2. Risk Control Measures

2.1 Risk Control Measures to Prevent HCW Exposure to or Infestation with Scabies

2.1.1 *Engineering Controls*

Administration should ensure that there is consideration of plastic-covered pillows and protected chairs in areas with communal use, e.g. psychiatry units, community health centres, physiotherapy and emergency departments. **BIII**

2.1.2 *Administrative Controls*

See Section A-2.1.2.

2.1.3 *OH Work Practices*

See Section A-2.1.3.

2.1.4 *Personal Protective Equipment*

OH should advise HCWs to wear gloves when entering the single room or designated bedspace in a shared room of a patient for whom Contact Precautions are in place for suspected or confirmed *Norwegian* scabies and to wear a gown if direct contact with the patient or environment is likely[4]. **BII**

OH should advise HCWs to wear gloves and a gown when providing direct care to a patient suspected or confirmed to have *typical* scabies[4]. **BII**

2.2 Risk Control Measures to Manage HCWs Exposed to or Infested with Scabies

2.2.1 *Assessment of HCW Exposure to Scabies*

2.2.1.1 Method of Transmission of Scabies

Typical/Norwegian scabies is transmitted by direct skin-to-skin contact with an infested individual. Occasionally it can be transmitted through

contact with the clothing or bedding of an infested individual but not usually with items such as furniture, though that is more likely with *Norwegian* scabies.

2.2.1.2 Definition of Occupational Exposure to Scabies

OH should define exposure to *typical* scabies as direct skin-to-skin contact with an infested patient before treatment and until 24 hours of effective treatment. **AIII**

OH should define exposure to *Norwegian* scabies as minimal direct or indirect contact with an infested patient before treatment and until 24 hours of effective treatment. Only minimal contact is required because of the large number of mites present on the source. **AIII**

2.2.2 *Assessment of Source of HCW Exposure*

In collaboration with IC, OH should confirm the diagnosis and the extent of infestation (i.e. *typical* or *Norwegian* scabies) of the source and assess the potential for communicability at the time of HCW exposure. **AIII**

2.2.2.1 Communicability of Source

The incubation period in persons without previous infestation with scabies (*typical/Norwegian*) is usually 4 to 6 weeks. Those who have been previously sensitized to scabies develop symptoms 1 to 4 days after repeat exposure to the mite[4]. The period of communicability continues as long as the patient remains infested and untreated, including the interval before symptoms develop[24].

2.2.3 *Criteria to Confirm the Diagnosis of Scabies*

Clinical illness – erythematous, maculopapular skin eruption, which is intensely itchy, particularly at night; thread-like burrow lines may be evident but are frequently obliterated by scratching, leaving the skin excoriated; crusted hyperkeratotic lesions characterize *Norwegian* scabies

Skin scraping may be considered for diagnosis and should be performed by someone skilled in the procedure. Results are frequently negative despite strong clinical evidence of infestation.

2.2.4 *OH Work Practices to Manage HCWs Exposed to or Infested with Scabies*

2.2.4.1 HCWs Exposed to Scabies

OH should not routinely use prophylaxis for HCWs exposed to *typical* scabies when there is no evidence of transmission[24,229,258,259]. **AII**

OH should refer HCWs exposed to *Norwegian* scabies for clinical management, which may include one or more applications of scabicide[24,229,253,254,257]. **AII**

OH should not exclude HCWs exposed to *typical* scabies[33,229,259]. **AIII**

OH should exclude HCWs exposed to *Norwegian* scabies until the HCW has completed one application of effective treatment[33,254]. **AII**

2.2.4.2 HCWs Symptomatic or Infested with Scabies

OH should refer HCWs who are symptomatic or infested with *typical* or *Norwegian* scabies for confirmation of diagnosis and for clinical management, which should include provision of scabicide and may include skin scraping for diagnosis[24,33]. **AIII**

OH should exclude HCWs infested with *typical* scabies until the HCW has completed one application of effective treatment[33,259] and has been assessed for fitness to work. **AIII**

OH should exclude HCWs infested with *Norwegian* scabies until after the HCW has completed the last application of effective treatment and has been assessed for fitness to work[257]. **AIII**

OH should advise HCWs that exposed household members and intimate contacts should seek medical evaluation from a public health nurse, community health centre, or physician regarding evaluation of risk, prophylaxis, diagnosis, and/or treatment[259]. **AIII**

OH should advise HCWs to return for assessment for fitness to work. **AIII**

2.2.4.3 OH Management of Scabies Outbreak

OH should consider the possibility of an outbreak if more than one HCW on the same unit meet the criteria for diagnosis. **AIII**

OH should consider the likelihood of an outbreak when even only one case of *Norwegian* scabies is identified[24,253,254,257]. **AII**

In collaboration with IC, OH should consider prophylaxis when transmission of *typical* scabies has occurred[256,258-264]. **AII**

OH should inform IC as soon as possible when a case of suspected or confirmed *Norwegian or typical* scabies occurs. **AIII**

OH should liaise with IC and public health authorities if an outbreak is suspected. **AIII**

OH and IC should arrange for the concurrent prophylaxis and/or treatment of staff and patients if an outbreak is declared[24,33,251,256,257]. **AII**

In consultation with IC, OH may modify work restrictions, as necessary, in outbreak situations. **BIII**

2.2.4.4 OH Reporting to Public Health Authorities of HCWs with Scabies

OH should report a suspected or confirmed outbreak to public health authorities as required by legislation.

3. Education of HCWs about Prevention and Management of Exposure to or Infestation with Scabies

OH should design education specific to scabies according to the recommendations outlined in Section A-3, to include

- prevention of transmission by maintaining a high index of suspicion, early recognition and diagnosis, and adequate treatment of index case(s)[250],
- the difference between *typical* and *Norwegian* scabies,
- the method and risk of transmission, e.g. likelihood increases with *Norwegian* scabies because of the increased number of mites,
- the long incubation period,
- the period of communicability and infectiousness prior to the onset of symptoms[254,261],
- the need for ongoing self-evaluation and reporting to OH about reinfestation, persistence, or recurrence of symptoms, e.g. rash or pruritis that intensifies at night,
- the importance of following product instructions for scabicide[262],
- the need for hot water washing or drycleaning, or storing in a sealed plastic bag for 7 days any clothes or bedding used up to 4 days prior to treatment[24],
- the lack of need for environmental disinfection for typical scabies[24],
- the need to vacuum environmental surfaces in a room used by a patient with *Norwegian* scabies[24],
- importance of pillow protection in areas with communal use, e.g. physiotherapy, clinics,
- consideration of vinyl-type rather than cloth upholstery for chairs in selected areas, e.g. psychiatry, emergency or physiotherapy units, community health centres,
- the need for evaluation, prophylaxis, and treatment of exposed household members and other intimate contacts[262],
- the need for assessment prior to return to work,
- caution regarding self diagnosis. **AIII**

4. Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infestation with Scabies

OH should refer to Section A-4 to develop an evaluation program specific to scabies, including

- rates of exposures or infestations for *Norwegian* scabies and the number of HCWs that required prophylaxis/treatment,
- rates of infestations for *typical* scabies and the number of HCWs that required treatment as a result of exposure to *typical* scabies related to transmission or infestation,
- time lost due to treatment or reinfestation. **AIII**

Staphylococcus aureus (*S. aureus*)

A. Methicillin-Sensitive *S. aureus* (MSSA)

1. Risk Assessment for Transmission of MSSA to HCWs

1.1 Clinical Significance of MSSA

Infection with *Staphylococcus aureus* causes a wide range of diseases, from localized to invasive. Localized diseases include wound infections, furuncles, and impetigo. Invasive infections include septicemia, osteomyelitis, arthritis, endocarditis, and pneumonia. *S. aureus* also causes toxin-mediated diseases, such as toxic shock syndrome, scalded skin syndrome, and food poisoning[24].

1.2 Evidence of Exposure/Transmission of MSSA

S. aureus is ubiquitous, and there are many strains. Approximately 20% to 30% of the population carry *S. aureus* in their anterior nares as part of their normal flora. Persons with draining lesions or any purulent discharge or with respiratory infection are the most common source of epidemic spread. The role of contaminated objects has been over-emphasized; the hands are the most important instrument in the spread of infection[23].

Nasal carriage among HCWs is an important hospital reservoir of *S. aureus*: about 25% of all hospital-based HCWs are nasal carriers. The organism is easily transferred to the hands, increasing the potential for transmission[265].

HCWs who are infected or colonized with *S. aureus* can serve as reservoirs of the organism and have been implicated in transmission[266-268].

Outbreaks caused by HCWs who are nasal carriers of *S. aureus* are relatively uncommon, but do occur[266]. The likelihood of a nasal carrier causing an outbreak may increase if the carrier acquires the ability to disperse the organism into the air; the term “cloud babies” was introduced to describe this situation[269]. Nasal carriers of *S. aureus* with concurrent viral upper respiratory tract infection have been shown to disperse *S. aureus* into the air and cause outbreaks[266,267,269].

Two different hospitals reported nursery outbreaks of staphylococcal skin disease and attributed them to a nurse who worked at both hospital nurseries on alternate weeks and was a nasal carrier of an unusual strain of *S. aureus.* The outbreaks occurred while she

experienced an upper respiratory tract illness, leading the authors to hypothesize that this was a situation analogous to the "cloud babies" described above[267].

A neurosurgeon found to be a chronic nasal carrier of *S. aureus* was associated with two nosocomial cases of postsurgical toxic shock syndrome infections occurring 4 years apart. There was no mention of whether the surgeon had a concurrent upper respiratory tract infection. Molecular epidemiologic testing was performed to prove the relatedness of the strains[268].

Resistant strains of *S. aureus* have emerged after the use of oral and topical antimicrobial agents prescribed to eradicate carriage in colonized HCWs or patients[270-273]. Current recommendations state that these agents should be used only when a HCW is epidemiologically linked to patient transmission[274].

Recommendations

Compliance with the recommendations for the components of an OH program outlined in Section A–1-4 is required in addition to the following specific recommendations for S. aureus.

2. Risk Control Measures

2.1 Risk Control Measures to Prevent HCW Exposure to or Infection with MSSA

2.1.1 *Engineering Controls*

See Section A-2.1.1.

2.1.2 *Administrative Controls*

See Section A-2.1.2.

2.1.3 *OH Work Practices*

See Section A-2.1.3.

2.1.4 *Personal Protective Equipment*

OH should advise HCWs to wear gloves when entering the single room or designated bedspace in a shared room of a patient for whom Contact Precautions are in place for suspected or confirmed MSSA, and to wear a gown if direct contact with the patient or environmental surfaces is likely[4]. **BII**

2.2 Risk Control Measures to Manage HCWs Exposed to or Infected with MSSA

2.2.1 *Assessment of HCW Exposure to MSSA*

2.2.1.1 Method of Transmission of MSSA

MSSA is transmitted by direct or indirect contact of skin or mucous membrane with MSSA-colonized or infected body sites, wound drainage or

respiratory secretions primarily as a result of HCW hand contamination and subsequent self-inoculation of the nares or transfer to individuals/the environment.

2.2.1.2 Definition of Occupational Exposure to MSSA

OH should define exposure as direct or indirect contact of non-intact skin or mucous membranes with MSSA-infected body sites, wound drainage or respiratory secretions. **AIII**

2.2.2 *Assessment of Source of HCW Exposure*

In collaboration with IC, OH should confirm the diagnosis of the source and assess the potential for communicability at the time of HCW exposure. **AIII**

2.2.2.1 Communicability of Source

The incubation period varies according to clinical presentation, host immune status, and use of effective antibiotic therapy. Communicability continues as long as purulent lesions continue to drain or the carrier state persists[23].

2.2.3 *Criteria to Confirm the Diagnosis of MSSA*

Clinical illness – localized furuncle, impetigo, wound infection, septicemia, osteomyelitis, arthritis, endocarditis, pneumonia, toxic shock syndrome, scalded-skin syndrome, or food poisoning

Plus laboratory evidence – bacterial culture of appropriate clinical specimen positive for methicillin-sensitive *S. aureus*

Or – compatible clinical illness in a HCW who is epidemiologically linked to a cluster of confirmed cases

2.2.4 *OH Work Practices to Manage HCWs Exposed to or Infected with MSSA*

2.2.4.1 HCWs Exposed to MSSA

OH should not routinely obtain specimens for culture from HCWs exposed to MSSA. **AIII**

There are no modifications to work practices or work restrictions for HCWs exposed to MSSA.

2.2.4.2 HCWs Colonized, Symptomatic, or Infected with MSSA

OH should only refer colonized HCWs for clinical management if they are epidemiologically linked to patient transmission[275]. **AII**

There are no modifications to work practices or work restrictions for HCWs colonized with MSSA if they are not linked epidemiologically to patient transmission.

OH should evaluate HCWs with signs and symptoms of infection, e.g. carbuncle or furuncle, and refer for clinical management as necessary. **AIII**

OH should refer HCWs with clinically significant MSSA infection for confirmation of diagnosis and for clinical management, which may include laboratory investigation and antibiotic therapy. **AIII**

OH should exclude HCWs with skin lesions on hands that are suspected or known to be caused by MSSA, e.g. carbuncle or furuncle, until the lesions have resolved and the HCW has been assessed for fitness for work. **AIII**

HCWs with lesions on sites other than their hands that are suspected or confirmed to be caused by MSSA should be excluded from contact with patients and their environment if the lesions cannot be effectively covered by dressings and clothing, or if the hygiene of the HCW is compromised, until lesions are healed. **AIII**

2.2.4.3 OH Management of MSSA Outbreak

OH should consider the possibility of an outbreak if more than one HCW from the same unit meet the criteria of diagnosis and appears to be linked epidemiologically. **AIII**

OH should liaise with IC and public health authorities if an outbreak is suspected. **AIII**

OH should ensure that specimens for culture are obtained from HCWs epidemiologically linked to a cluster of clinically significant nosocomial MSSA cases in patients. **AIII**

OH should refer HCWs colonized with MSSA and epidemiologically linked to patient transmission for medical assessment, which should include laboratory investigation with molecular typing and therapy for decolonization[267,276,277]. **AII**

OH should exclude HCWs colonized with MSSA if they are found to be epidemiologically linked to patient transmission(s) until medical assessment and antibiotic therapy has been completed and appropriate control measures and/or work restrictions have been assigned[267,276,277]. **AII**

OH should assess HCWs colonized with MSSA and epidemiologically linked to patient transmission for fitness for work; assess the type of

patient/physical setting/work, hygiene practices, and the risk control measures that can be used; and establish a follow-up schedule. **AIII**

2.2.4.4 OH Reporting to Public Health Authorities of HCWs with MSSA

There are no requirements to report a single case; OH should report a suspected or confirmed outbreak to public health authorities as required by legislation.

3. Education of HCWs about Prevention and Management of Exposure to or Infection with MSSA

OH should design education specific to MSSA according to the recommendations outlined in Section A-3, to include

- similarities and differences between MSSA and methicillin-resistant *S. aureus* (MRSA),
- the meaning of colonization/infection,
- the possibility of intermittent/prolonged shedding,
- specimens for culture recommended only for HCWs linked to patient transmission,
- decolonization therapy considered only when there are links to patient transmission,
- the role of contaminated hands and dermatitis or lesions of HCWs in transmission. **AIII**

4. Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infection with MSSA

OH should refer to Section A-4 to develop an evaluation program specific to MSSA, including

- the number of HCWs with MSSA infections that are epidemiologically linked to MSSA transmission,
- the number of HCWs with clinically significant MSSA infections,
- time lost due to infections that are epidemiologically linked to transmission or clinically significant infections. **AIII**

B. Methicillin-Resistant *S. aureus* (MRSA)

1. Risk Assessment for Transmission of MRSA to HCWs

1.1 Clinical Significance of MRSA

Methicillin resistance in *S. aureus* rapidly developed after the introduction of methicillin. The subsequent spread throughout the world of organisms resistant to methicillin and related antibiotics created a myriad of problems in therapeutic choices and patient management, including isolation[278].

MRSA are capable of causing the same conditions as methicillin sensitive strains of *S. aureus,* such as bacteremias, infections involving postoperative burns and wounds, intravascular cannula-related infections, pneumonias, and omphalitis[279].

The morbidity and mortality associated with nosocomial MRSA infections are comparable with those seen with susceptible strains of *S. aureus*[280,281].

1.2 Evidence of Exposure/Transmission of MRSA

MRSA outbreaks or infections occur more often in elderly or immunocompromised patients or in patients with severe chronic medical conditions[279,280,282].

The increase in community-acquired MRSA may be the result of transmission from persons who acquired MRSA while in the hospital[24].

The Canadian Hospital Epidemiology Committee (CHEC) initiated national surveillance for MRSA in 1995; 23 sentinel hospitals across the country participate. During the first 4 years of surveillance a total of 2,450 new cases were reported from 22 hospital sites, for a mean rate of 2.4/100 *S. aureus* isolates (range: 0.1-19.0) This rate represents an increase in each year studied, from 0.9% in 1995 to 1.7% (1996), 2.6% (1997), and 3.9% (1998)[284].

Four epidemic strains have been found through molecular analysis of the Canadian MRSA isolates identified since 1995. The epidemic strains may possess additional virulence factors contributing to their persistence and transmission in hospitals across Canada[285].

The economic impact of MRSA to Canadian hospitals has been estimated to be $33M-$42M(CDN) annually and rising with the increasing incidence of MRSA[286].

Transmission of MRSA in hospitals occurs primarily through the hands of HCWs, which are contaminated during contact with colonized or infected body sites of patients[274,278,280-283].

Nasal carriers of MRSA have been shown to carry the same strain on their hands; this finding emphasizes the importance of handwashing between caring for patients to prevent cross transmission[265].

In two hospitals (a 642-bed medical-surgical facility with both acute and long-term care divisions and a 707-bed psychiatric facility), MRSA soft tissue infections were diagnosed in five employees. Four of the five presented to the Employee Health Service and the fifth reported to the Infectious Disease Clinic. All employees had had direct exposure to patients colonized with MRSA. In the conclusion of this case-series study, the authors noted that HCWs in hospitals with endemic MRSA may acquire MRSA infection[287].

The use of epidemiologic principles identified a HCW with chronic MRSA sinusitis and led to detection and control of a hospital-wide outbreak of MRSA. The outbreak was controlled without extensive culturing of personnel or environmental surfaces and without routine administration of decolonization regimens[288].

It has been suggested that known *S. aureus* shedders should wear a mask when they are experiencing an upper respiratory tract infection as a way to minimize the spread of *S. aureus* to patients[266].

Recommendations

Compliance with the recommendations for the components of an OH program outlined in Section A–1-4 is required in addition to the following specific recommendations for MRSA.

2. Risk Control Measures

2.1 Risk Control Measures to Prevent HCW Exposure to or Infection with MRSA

2.1.1 *Engineering Controls*

See Section A-2.1.1.

2.1.2 *Administrative Controls*

See Section A-2.1.2.

2.1.3 *OH Work Practices*

See Section A-2.1.3.

2.1.4 *Personal Protective Equipment*

OH should advise HCWs to wear gloves when entering the single room or designated bedspace in a shared room of a patient for whom Contact Precautions are in place for suspected or confirmed MRSA, and to wear a gown if direct contact with the patient or environmental surfaces is likely[4]. **BII**

OH should advise HCWs to consider wearing a surgical/procedure mask when providing direct care for a patient known to have MRSA nasal or respiratory colonization with a superimposed respiratory infection, or if the rate of HCW acquisition of nasal colonization with MRSA is high[4]. **C**

OH should advise a HCW known to be an MRSA carrier to wear a surgical/procedure mask when the HCW has an upper respiratory tract infection[266]. **BIII**

2.2 Risk Control Measures to Manage HCWs Exposed to or Infected with MRSA

2.2.1 *Assessment of HCW Exposure to MRSA*

2.2.1.1 Method of Transmission of MRSA

MRSA is transmitted by direct or indirect contact of skin or mucous membranes with MRSA-colonized or infected body sites, wound drainage or respiratory secretions primarily as a result of hand contamination and subsequent self-inoculation of the nares or transfer to individuals/the environment.

2.2.1.2 Definition of Occupational Exposure to MRSA

OH should define exposure as direct or indirect contact of non-intact skin or mucous membranes with MRSA-colonized or infected body sites, wound drainage, or respiratory secretions. **AIII**

2.2.2 *Assessment of Source of HCW Exposure*

In collaboration with IC, OH should confirm the diagnosis of the source and assess the potential for communicability at the time of HCW exposure. **AIII**

2.2.2.1 Communicability of Source

The incubation period varies widely according to clinical presentation, host immune status, and use of effective antibiotic therapy. Communicability continues as long as purulent lesions drain or the carrier state persists[23].

2.2.3 *Criteria to Confirm the Diagnosis of MRSA*

Clinical illness – localized furuncle, impetigo, wound infection, septicemia, osteomyelitis, arthritis, endocarditis, pneumonia, toxic shock syndrome, scalded-skin syndrome, or food poisoning

Or colonization

Plus laboratory evidence – bacterial culture of appropriate clinical specimen positive for MRSA

Or – compatible clinical illness or colonization in a HCW who is epidemiologically linked to a confirmed case

2.2.4 *OH Work Practices to Manage HCWs Exposed to or Infected with MRSA*

2.2.4.1 HCWs Exposed to MRSA

OH should not routinely obtain specimens for culture from HCWs exposed to MRSA[278,280]. **AII**

There are no modifications to work practices or work restrictions for HCWs exposed to MRSA.

2.2.4.2 HCWs Colonized, Symptomatic, or Infected with MRSA

OH should refer HCWs colonized, symptomatic, or infected with MRSA for confirmation of diagnosis and for clinical management, which should include laboratory investigation with molecular typing and antibiotic therapy for decolonization and/or treatment[279,280,287,288]. **AIII**

OH should exclude HCWs colonized with MRSA until medical assessment and decolonization therapy are complete and appropriate control

measures, which may include periodic screening and/or work restrictions, have been assigned[274,289]. **AIII**

OH should exclude HCWs with symptoms or infections that are suspected or known to be caused by MRSA (carbuncle, furuncle) until antibiotic therapy for treatment and decolonization is complete, lesions have resolved, medical assessment is complete, and appropriate control measures and/or work restrictions have been assigned[274]. **AII**

OH should assess HCWs colonized, symptomatic, or infected with MRSA for fitness for work; assess the type of patient/physical setting/work, hygiene practices, the risk control measures that can be used; and establish a follow-up schedule. **BIII**

OH should inform IC as soon as possible of a HCW who is colonized or infected. **AIII**

2.2.4.3 OH Management of MRSA Outbreak

OH should obtain specimens for culture from HCWs only when they have been epidemiologically linked to patient transmission[266,274,278,280,288]. **AII**

OH should consider the possibility of an outbreak if more than one HCW from the same unit meet the criteria for diagnosis[289]. **BII**

OH should liaise with IC and public health authorities if an outbreak is suspected[283,289]. **BII**

OH should refer HCWs colonized with MRSA and epidemiologically linked to patient transmission for medical assessment, which should include laboratory investigation with molecular typing and antibiotic therapy for decolonization[266,274,278-280,288]. **AII**

OH should exclude HCWs colonized with MRSA if they are found to be epidemiologically linked to patient transmission until antibiotic therapy and medical assessment are complete and appropriate control measures and/or work restrictions have been assigned[274]. **AII**

OH should assess HCWs colonized with MRSA and epidemiologically linked to patient transmission for fitness for work; assess the type of patient/physical setting/work, hygiene practices, the risk control measures that can be used; and establish a follow-up schedule. **AIII**

In consultation with IC, OH may modify work practices during an outbreak, e.g. by assigning MRSA-colonized HCWs to patients with the same strain. **BIII**

2.2.4.4 OH Reporting to Public Health Authorities of HCWs with MRSA

OH should report a case and a suspected or confirmed outbreak to public health authorities as required by legislation.

3. Education of HCWs about Prevention and Management of Exposure to or Infection with MRSA

OH should design education specific to MRSA according to the recommendations outlined in Section A-3, to include

- similarities and differences between MSSA and MRSA,
- the meaning of colonization and infection,
- the possibility of intermittent or prolonged shedding,
- factors that increase transmission, i.e. respiratory tract infections or lesions[266,279],
- prevention of transmission, e.g. use of masks when an MRSA positive HCW has a respiratory infection; reassignment[266],
- the reason why risk is primarily to patients, not HCWs,
- the role of dermatitis, lesions, or contaminated hands in transmission,
- the need to report to OH if the HCW has draining lesions or dermatitis, or if symptoms recur,
- the fact that cultures are recommended only when linked to patient transmission,
- decolonization therapy. **AIII**

4. Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infection with MRSA

OH should refer to Section A-4 to develop an evaluation program specific to MRSA, including

- the number of HCWs with MRSA infections,
- time lost due to MRSA infections,
- the number of HCWs with MRSA epidemiologically linked to transmission,
- time lost due to MRSA epidemiologically linked to transmission. **AIII**

Streptococcus, Group A (GAS)

1. Risk Assessment for Transmission of GAS to HCWs

1.1 Clinical Significance of GAS

Infection with group A (beta hemolytic) streptococcus (GAS) causes a wide range of diseases, ranging from localized to invasive. The most common clinical illnesses are respiratory and skin/soft tissue conditions. GAS can, however, cause severe invasive disease, including necrotizing fasciitis and toxic shock syndrome.

1.2 Evidence of Exposure/Transmission of GAS

Since the late 1980s there has been a resurgence of GAS infection presenting as toxic shock syndrome, necrotizing fasciitis, or myositis[290-292]. This emergence may be due to a highly virulent clone of a specific strain[291] or host factors that determine the severity of infection[292].

In a recent prospective, population-based surveillance study in Ontario, the incidence of invasive GAS disease was reported to be 1.5 cases per 100,000 population per year. The authors concluded that patients at greatest risk for invasive GAS disease, including toxic shock syndrome and necrotizing fasciitis, are the elderly and those with underlying medical conditions. There is some risk of transmission of invasive disease in households and health care institutions[293].

The transmission of GAS in hospitals can be prevented by improving infection control practices, and identifying and treating staff members who are symptomatic[294-298].

Outbreaks involving a variety of patient groups (e.g. postpartum women and newborns, postoperative surgical patients, burn patients, and patients in geriatric wards or extended care facilities) have been reported[299].

Health care providers have been epidemiologically or microbiologically linked as the source to the index case[294-296,300-307]. HCWs were typically asymptomatic[294,297,300,301,304-308]. The pharynx, vagina, rectum, or skin of HCWs were found to be the sites of colonization or infection. The source of infection for some HCWs may have been family members[295,297,303,304,309,310].

Active surveillance during outbreaks has often identified additional personnel as colonized by the epidemic strain and HCWs with clinical infections as secondary cases[295,298,299,311].

Formal case-control studies and review of common hospital contacts of infected patients have been useful in identifying HCWs as possible index cases. Typing of the epidemic streptococcal strain has been a widely used research tool to investigate the extent of the outbreak and to aid in determining whether a colonized HCW is the index case[299].

Several investigators have demonstrated GAS in the air when HCWs with rectal or vaginal carriage exercise or change clothes[294,303,305,308]. HCWs with rectal or vaginal carriage of GAS who perform surgery may have transient scalp colonization, resulting in contamination of wound sites during surgery. Infected skin sites have also been suspected of direct transmission[296,309].

One study using molecular and serotyping procedures reported that three HCWs developed symptomatic GAS infection following exposure to patients with invasive disease. The authors concluded that close contact with invasive GAS places HCWs at risk when exposed to secretions from infected patients[290].

There have also been studies to suggest the possibility of GAS transmission between patients and HCWs in nursing homes[298,312].

Although some jurisdictions recommend and offer prophylaxis for close contacts of GAS-associated necrotizing fasciitis, toxic shock syndrome, meningitis, pneumonia, or any form of GAS that results in death[313,314], the most effective approach to manage contacts remains controversial[293].

Recommendations

Compliance with the recommendations for the components of an OH program outlined in Section A–1-4 is required in addition to the following recommendations for GAS.

2. Risk Control Measures

2.1 Risk Control Measures to Prevent HCW Exposure to or Infection with GAS

2.1.1 *Engineering Controls*

See Section A-2.1.1.

2.1.2 *Administrative Controls*

See Section A-2.1.2.

2.1.3 *OH Work Practices*

See Section A-2.1.3.

2.1.4 *Personal Protective Equipment*

OH should advise HCWs to wear gloves when entering the single room or designated bedspace in a shared room of a patient for whom Contact Precautions are in place for suspected or confirmed major skin/soft tissue infection with GAS, and to wear a gown if direct contact with the patient or environmental surfaces is likely[4]. **BII**

OH should advise HCWs to wear a surgical/procedure mask if they are within 1 m of a pediatric patient for whom Droplet Precautions are in place for suspected or confirmed GAS pneumonia, pharyngitis, or scarlet fever[4]. **BIII**

2.2 Risk Control Measures to Manage HCWs Exposed to or Infected with GAS

2.2.1 *Assessment of HCW Exposure to GAS*

2.2.1.1 Method of Transmission of GAS

GAS is transmitted by droplet, direct, or indirect contact of the oral or nasal mucous membranes with infectious respiratory or wound secretions; or by direct contact of non-intact skin with infectious respiratory or wound secretions.

2.2.1.2 Definition of Occupational Exposure to GAS

OH should define exposure as droplet, direct, or indirect contact of oral or nasal mucous membranes or as direct contact of non-intact skin with infectious respiratory or wound secretions from patients with invasive disease (necrotizing fasciitis, toxic shock syndrome, meningitis, pneumonia, or any form of GAS that results in death) from within 7 days before the onset of GAS until 24 hours of effective antibiotic therapy. **AIII**

2.2.2 *Assessment of Source of HCW Exposure*

In collaboration with IC, OH should confirm the diagnosis of the source and assess the potential for communicability at the time of HCW exposure. **AIII**

2.2.2.1 Communicability of Source

The incubation period is variable according to the clinical syndrome, usually 1 to 3 days. The period of communicability is from 7 days before the onset of GAS until 24 hours of effective antibiotic treatment has been completed.

2.2.3 *Criteria to Confirm the Diagnosis of GAS*

Clinical illness – pharyngitis, scarlet fever, skin/soft tissue infection, myositis, endometritis, bacteremia, meningitis, necrotizing fasciitis, or toxic shock syndrome

Plus laboratory evidence – antigen detection assay positive for group A streptococcus; bacterial culture of appropriate clinical specimen positive for group A streptococcus

Or colonization in an individual who is epidemiologically linked to a confirmed case within the appropriate incubation time

2.2.4 *OH Work Practices to Manage HCWs Exposed to or Infected with GAS*

2.2.4.1 HCWs Exposed to GAS

OH should not routinely obtain specimens for culture from HCWs exposed to GAS. **AIII**

OH should refer for clinical management HCWs exposed to GAS necrotizing fasciitis, toxic shock syndrome, meningitis, or an invasive GAS case that resulted in death; clinical management may include laboratory investigation and prophylaxis[293] as recommended by provincial/territorial guidelines[313,314]. **AIII**

There are no modifications to work practices or work restrictions for HCWs exposed to GAS.

2.2.4.2 HCWs Colonized, Symptomatic, or Infected with GAS

OH should only refer colonized HCWs for clinical management if they are epidemiologically linked to patient transmission[275]. **AIII**

There are no modifications to work practices or work restrictions for HCWs colonized with GAS if they are not linked epidemiologically to patient transmission. **AIII**

OH should evaluate HCWs with signs or symptoms of GAS infection, e.g. rash or sore throat, and refer them for clinical management as necessary[275]. **AIII**

OH should refer HCWs with clinically significant GAS infection for confirmation of diagnosis and for clinical management, which should include laboratory investigation and antibiotic therapy[299,313,314]. **AIII**

OH should exclude HCWs with clinically significant GAS infection from work until completion of 24 hours of effective antibiotic therapy[4,299,313,314]. **AIII**

OH should inform IC as soon as possible of HCWs with suspected or confirmed invasive GAS disease (necrotizing fasciitis, toxic shock syndrome, meningitis, or any form of GAS that results in death). **AIII**

2.2.4.3 OH Management of GAS Outbreak

OH should consider the possibility of an outbreak if more than one HCW on the same unit meet the criteria for diagnosis and appear to be linked epidemiologically to patient transmission. **AIII**

OH should liaise with IC and public health authorities if an outbreak is suspected or confirmed. **AIII**

OH should ensure that specimens for culture (throat, rectal, vaginal, and skin lesions) are obtained from HCWs epidemiologically linked to clinically significant nosocomial GAS case(s) in patients e.g. surgical wounds, endometritis, cellulitis, necrotizing fasciitis, toxic shock syndrome[30,295,296,299,303,309,315,316]. **AII**

OH should refer HCWs colonized with GAS and epidemiologically linked to patient transmission for medical assessment, which should include laboratory investigation with serotyping and antibiotic therapy[296,299,303,305,309,315,316]. **AII**

OH should exclude HCWs who are colonized, symptomatic, or infected with GAS if they are found to be epidemiologically linked to transmission until 24 hours of treatment with effective antibiotics is complete, medical assessment is complete, and appropriate control measures and/or work restrictions have been assigned[30,299,303,315,316]. **AII**

OH should assess HCWs who are colonized, symptomatic, or infected and epidemiologically linked to transmission for fitness to work; assess the type of patient/physical setting/work, hygiene practices, and control measures that can be used; and establish a follow-up schedule. **AIII**

2.2.4.4 OH Reporting to Public Health Authorities of HCWs with GAS

OH should report a case of GAS necrotizing fasciitis or toxic shock syndrome, or a suspected or confirmed outbreak of GAS to public health authorities as required by legislation.

3. Education of HCWs about Prevention and Management of Exposure to or Infection with GAS

OH should design education specific to GAS according to the recommendations outlined in Section A-3, to include the following information:

- specimens for culture are only obtained if the HCW is epidemiologically linked to clinically significant nosocomial GAS cases(s) in patients,
- prophylaxis is controversial and may or may not be offered to HCWs exposed to serious disease according to provincial/territorial policy,

- there are differences in clinical manifestations and severity of illness,
- illness should be reported to OH[316],
- similar symptoms in family members should be reported[290,295,297] to OH,
- symptomatic family members should seek medical evaluation. **AIII**

4. Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infection with GAS

OH should refer to Section A-4 to develop an evaluation program specific to GAS, including

- the number of HCWs that receive prophylaxis as a result of exposure,
- the rates of exposures and infections. **AIII**

Tinea (Ringworm)

1. Risk Assessment for Transmission of Tinea to HCWs

1.1 Clinical Significance of Tinea

Tinea is a fungal disease of the skin (*Tinea corporis*), scalp (*T. capitis*) and feet (*T. pedis*)[23]. *Trichophyton tonsurans* is the most common cause of *T. capitis*[317].

The infection can be confused with many diseases, and the fungus can remain viable on contaminated items or surfaces, thus providing reservoirs for transmission[24].

1.2 Evidence of Exposure/Transmission of Tinea

A 3-year retrospective review of mycology data from a long-stay ward in which there had been *T. tonsurans* infections over a 9-year period identified 33 mycology samples from nine patients, three staff, and one child of an affected staff member. The authors concluded that it is important to examine all staff and patients in institutional outbreaks, even in the absence of clinical disease, and to perform appropriate mycological testing[317].

An outbreak of *T. corporis*, in which nine of 30 HCWs (30%) were infected, was traced to a patient whose tinea infection had gone undiagnosed for 5 weeks. Seven of the nine HCWs provided direct care to the index patient, and the remaining two had indirect contact through handling soiled linen[318].

In another study, despite early diagnosis and treatment of a child infected with *T. corporis*, the infection was transmitted to four HCWs. HCW lesions involved unprotected skin that had been in direct physical contact with the index case[319].

Thirteen of 22 HCWs on a pediatric ward who had frequent, unprotected contact with a child with undiagnosed scalp lesions developed *T. corporis*. Most HCWs were able to cover their lesions while at work; one HCW with extensive lesions was excluded from work for 14 days[320].

Recommendations

Compliance with the recommendations for the components of an OH program outlined in Section A–1-4 is required in addition to the following specific recommendations for tinea.

2. Risk Control Measures

2.1 Risk Control Measures to Prevent HCW Exposure to or Infection with Tinea

2.1.1 *Engineering Controls*

See Section A-2.1.1.

2.1.2 *Administrative Controls*

See Section A-2.1.2.

2.1.3 *OH Work Practices*

See Section A-2.1.3.

2.1.4 *Personal Protective Equipment*

See Section A-2.1.4.

2.2 Risk Control Measures to Manage HCWs Exposed to or Infected with Tinea

2.2.1 *Assessment of HCW Exposure to Tinea*

2.2.1.1 Method of Transmission of Tinea

Tinea is transmitted through direct or indirect skin contact with the scalp or skin lesions of an infectious individual or animal, or with a contaminated environment.

2.2.1.2 Definition of Occupational Exposure to Tinea

OH should define exposure as direct or indirect skin contact with infectious skin or scalp lesions or contaminated environmental surfaces. **AIII**

2.2.2 *Assessment of Source of HCW Exposure*

In collaboration with IC, OH should confirm the diagnosis of the source and assess the potential for communicability at the time of the HCW exposure. **AIII**

2.2.2.1 Communicability of Source

The minimum incubation period of *T. corporis* is 5 to 7 weeks but may be longer[319]. The period of communicability is for as long as lesions are present[4] or viable fungus persists on contaminated environmental surfaces[23].

2.2.3 *Criteria to Confirm the Diagnosis of Tinea*

Clinical illness – skin lesions of feet, body, or head frequently well demarcated, itchy, pustular, and scaly; they may involve hair loss

With or **Without** laboratory evidence – microscopic examination of skin scrapings or hair positive for tinea; culture of skin scrapings or hair

2.2.4 *OH Work Practices to Manage HCWs Exposed to or Infected with Tinea*

2.2.4.1 HCWs Exposed to Tinea

There are no modifications to work practices and no work exclusions for HCWs exposed to tinea.

2.2.4.2 HCWs Symptomatic or Infected with Tinea

OH should refer HCWs symptomatic or infected with tinea for confirmation of diagnosis and for clinical management, which may include laboratory investigation and treatment. **AIII**

OH should instruct HCWs with tinea to cover lesions with occlusive dressings while at work and should reinforce handwashing[318-320]. **AIII**

OH should reassign HCWs with tinea to non-patient care duty when lesions cannot be covered or are present on hands or forearms and handwashing is compromised[320]. **AIII**

2.2.4.3 OH Management of Tinea Outbreak

OH should consider the possibility of an outbreak if more than one HCW on the same unit meet the criteria for diagnosis. **AIII**

OH should liaise with IC and public health authorities if an outbreak is suspected. **AIII**

OH should consider the examination of all staff during institutional outbreaks, even in the absence of clinical disease, and perform appropriate mycological testing[317]. **BIII**

2.2.4.4 OH Reporting to Public Health Authorities of HCWs with Tinea

There is no reporting requirement for a single case; OH should report a suspected or confirmed outbreak to public health authorities as required by legislation.

3. Education of HCWs about Prevention and Management of Exposure to or Infection with Tinea

OH should design education specific to tinea according to the recommendations outlined in Section A-3; education should include the need to disinfect contaminated environmental surfaces with an approved hospital disinfectant[23]. **AIII**

4. Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infection with Tinea

OH should refer to Section A-4 to develop an evaluation program specific to tinea, including

- the number of HCWs with infections,
- the number of reassignments due to infection. **AIII**

Tuberculosis (TB)

Administration should ensure that OH develops policies and procedures for the prevention and management of HCW exposure to and/or infection with TB according to Health Canada's *Guidelines for Preventing the Transmission of Tuberculosis in Canadian Health Care Facilities and Other Institutional Settings (1996)*[17], *A National Consensus on Guidelines for Establishment of a Post-Exposure Notification Protocol for Emergency Responders*[19,96-99,114], and according to the *Canadian Tuberculosis Standards* – Fourth Edition[321], and related provincial/territorial recommendations.

Vancomycin-Resistant Enterococcus (VRE)

The majority of the following information has been adapted from Health Canada's *Preventing the Spread of Vancomycin-Resistant Enterococci (VRE) in Canada.* The reader is encouraged to obtain the document for reference[14].

1. Risk Assessment for Transmission of VRE to HCWs

1.1 Clinical Significance of VRE

Enterococci are normal commensal flora of the gastrointestinal tract present in 95% of healthy individuals, and non-pathogenic colonizing flora in the vagina, oral cavity, perineal area, hepatobiliary tract, and upper respiratory tract. Enterococcus species are important nosocomial pathogens, having emerged as the second or third most common cause of nosocomial infections. Open wounds and decubitus ulcers may be colonized and may act as reservoirs. Enterococci are hardy organisms and are able to survive on environmental surfaces for extended periods.

Over the past two decades there have been increasing numbers of reports of enterococcus species with resistance to multiple antibiotics. Resistance to vancomycin in *Enterococcus faecium* and *E. faecalis* is of concern, as the resistance trait is transferable and raises the potential for emergence of vancomycin-resistant *Staphylococcus aureus* or coagulase negative staphylococci, creating major therapeutic dilemmas.

Although VRE are important nosocomial pathogens when they are associated with colonization or infection in certain patients, the risk to HCWs of becoming colonized is minimal[322-324].

1.2 Evidence of Exposure/Transmission of VRE

Certain patient populations are at increased risk of VRE infection and colonization. Patients (adult and pediatric) from critical care units, hematology/oncology wards, dialysis units, or transplantation units, or patients who have had major abdominal or thoracic procedures appear to be at higher risk than other populations. Healthy individuals do not become infected.

In the U.S. there was a 23-fold rise in VRE infection between 1989 and 1993, from 0.3% to 7.9% of nosocomial enterococcal infections reported to the National Nosocomial Infections Surveillance system at the CDC[325].

The first isolates of VRE in Canada were identified from two patients in 1993[326]. The first outbreak, in the fall of 1995, involved 41 patients and primarily affected those undergoing dialysis[327].

In a 1998 survey by the Canadian Hospital Epidemiology Committee (CHEC), representing 21 health care facilities across Canada, it was found that most of the sites had appropriate laboratory procedures for the detection and confirmation of VRE[328]. In addition, information from the Canadian Nosocomial Infection Surveillance Program (CNISP) sites demonstrated that increasing numbers of Canadian acute care facilities were identifying patients with VRE[322].

HCWs colonized with VRE have rarely been implicated in its transmission[323].

One study suggested that HCWs and their household contacts are at some risk of acquiring vancomycin-resistant *E. faecium*. VRE stool colonization was identified in 3/52 households (6%) whose members included patient-contact employees[324].

No transmission to HCWs in Canada has been reported[322].

Recommendations

Compliance with recommendations for the components of an OH program outlined in Section A–1-4 is required in addition to the following specific recommendations for VRE.

2. Risk Control Measures

2.1 Risk Control Measures to Prevent HCW Exposure to or Infection with VRE

2.1.1 *Engineering Controls*

See Section A- 2.1.1.

2.1.2 *Administrative Controls*

See Section A- 2.1.2.

2.1.3 *OH Work Practices*

See Section A- 2.1.3.

2.1.4 *Personal Protective Equipment*

OH should advise HCWs to wear gloves when entering the single room or designated bedspace in a shared room of a patient for whom Contact Precautions are in place for suspected or confirmed VRE, and to wear a gown if direct contact with the patient or environmental surfaces is likely[4]. **BII**

2.2 Risk Control Measures to Manage HCWs Exposed to or Infected with VRE

2.2.1 *Assessment of HCW Exposure to VRE*

2.2.1.1 Method of Transmission of VRE

VRE is transmitted by direct or indirect contact of hands or skin with infectious feces, urine, or wound drainage, or with areas of colonized skin.

2.2.1.2 Definition of Occupational Exposure to VRE

OH should define exposure as direct or indirect contact of hands or skin with feces, urine, or wound drainage, or areas of colonized skin in an infected or colonized patient. **AIII**

2.2.2 *Assessment of Source of HCW Exposure*

In collaboration with IC, OH should confirm the diagnosis of the source and assess the potential for communicability at the time of HCW exposure. **AIII**

2.2.2.1 Communicability of Source

The incubation period varies widely according to clinical presentation, host immune defences, and use of effective antibiotic treatment. Communicability continues for as long as the carrier state persists.

2.2.3 *Criteria to Confirm the Diagnosis of VRE*

Laboratory evidence – bacterial culture of appropriate clinical specimen positive for a vancomycin-resistant enterococcus; mainly seen in *E. faecalis*, *E. faecium*

Or – colonization in a HCW who is epidemiologically linked to a confirmed case in an outbreak

2.2.4 *OH Work Practices to Manage HCWs Exposed to or Infected with VRE*

2.2.4.1 HCWs Exposed to VRE

OH should not routinely obtain specimens for culture from exposed HCWs[329]. **AIII**

There are no modifications to work practices and no work restrictions for HCWs exposed to VRE.

2.2.4.2 HCWs Colonized with VRE

OH should refer HCWs who are colonized with VRE for confirmation of diagnosis and for clinical management, which should include laboratory investigation with molecular typing[329]. **AIII**

OH should exclude from work HCWs who are colonized with VRE and have diarrhea until symptoms resolve, medical assessment is complete and appropriate control measures and/or work restrictions have been assigned. **AIII**

OH should assess HCWs colonized with VRE who have diarrhea for fitness for work; assess the type of patient/work/physical setting, hygiene practices, and risk control measures that may be used; and establish a follow-up schedule. **AIII**

OH should inform IC as soon as possible of a HCW who is colonized with VRE. **AIII**

2.2.4.3 OH Management of VRE Outbreak

OH should consider the possibility of an outbreak if more than one HCW on the same unit meet the criteria for diagnosis. **AIII**

OH should liaise with IC and public health authorities if an outbreak is suspected. **AIII**

OH should refer HCWs colonized with VRE and epidemiologically linked to patient transmission for medical assessment, which may include laboratory investigation with molecular typing. **AIII**

OH should exclude HCWs colonized with VRE if they are found to be epidemiologically linked to patient transmission until medical assessment is complete and appropriate control measures and/or work restrictions have been assigned[329]. **AIII**

OH should assess HCWs colonized with VRE and epidemiologically linked to patient transmission for fitness to work; assess the type of patient/physical setting/work, hygiene practices, and risk control measures that can be used; and establish follow-up procedures. **AIII**

2.2.4.4 OH Reporting to Public Health Authorities of HCWs with VRE

OH should report a case or a suspected or confirmed outbreak to public health authorities as required by legislation.

3. Education of HCWs about Prevention and Management of Exposure to or Infection with VRE

OH should design education specific to VRE according to the recommendations outlined in Section A-3, to include

- similarities or differences between sensitive and resistant enterococcus,
- the difference between infection and colonization,

- the reason why the risk is primarily to patients rather than HCWs,
- the possibility of intermittent or prolonged fecal shedding,
- factors that increase transmission, e.g. diarrhea, contaminated environment,
- factors that prevent transmission, i.e. Routine Practices and Additional Precautions
- the role of contaminated hands of HCWs in transmission. **AIII**

4. Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infection with VRE

OH should refer to Section A-4 to develop an evaluation program specific to VRE. **AIII**

Varicella-Zoster Virus (VZV)

A. Varicella (Chickenpox)

1. Risk Assessment for Transmission of Varicella to HCWs

1.1 Clinical Significance of Varicella

Varicella-zoster virus (VZV) is the causative agent of both varicella (chickenpox) and herpes zoster (shingles), a reactivation of latent VZV.

Varicella is one of the most communicable of diseases, especially in the early stages of the eruption[23]. It is generally a mild disease in healthy children. Serious morbidity and mortality may result if infection occurs in neonates, adults, or immunosuppressed patients[23,330,331]. In Canada, 70% of reported deaths (37 of 53) due to varicella from 1987 to 1996 occurred in adolescents and adults > 15 years of age[332].

There is insufficient evidence to support the suggestion that varicella causes more severe illness in pregnant women than in other adults[333]. Maternal infection during the first or early second trimester of pregnancy may result in transmission of VZV to the fetus and cause congenital varicella syndrome. Maternal infection 5 days before through 2 days after delivery can result in severe varicella of the newborn infant. Before effective viral therapies became available, fatality rates as high as 30% were reported, but are likely lower now[23].

In a small Canadian multi-centre study of the financial burden of varicella from a medical and societal prospective, a total yearly cost of $122.4 million or $353.00 per individual case was estimated[334,335].

1.2 Evidence of Exposure/Transmission of Varicella

A history of varicella is highly reliable in determining immunity to the virus[166,332,336,337]. Serologic tests are required for those who have an uncertain or negative history[7,166,332,337].

Adults who have emigrated from subtropical areas have lower rates of seropositivity and, hence, are more often susceptible to VZV[338,339].

Rates of HCW susceptibility to VZV are reported to be between 1.9% and 10%[340,341]. In a study to determine susceptibility to VZV infection among various populations in Newfoundland, 6.9% of HCWs (373/5,386) were found to be susceptible[342].

In a study to determine the VZV risks for pediatric health care providers, 28% of those with uncertain or no known history of varicella were found to be susceptible[343]. Individuals < 35 years of age without previous history of VZV infection were more likely to be susceptible[340].

Sixty percent of 170 Canadian health care facilities responding to a survey were found to have well-established pre-employment varicella-zoster screening programs for HCWs, 30% imposed work restrictions for susceptible HCWs, and 49% used negative pressure rooms for infectious patients[344].

Varicella is now a vaccine-preventable disease: a vaccine was licensed for use in Canada in December 1998[7,332]. When a varicella vaccine program is being developed, the cost of identifying and vaccinating susceptible HCWs, the risks of administering a live vaccine, and the possibility of spread of vaccine-induced disease must be considered[336,345,346].

Vaccine has been shown to be effective in postexposure prophylaxis[347,348] but should not be a substitute for an immunization program[7,332]. In a population of shelter residents, varicella vaccine given 36 hours after exposure was highly effective in preventing disease. No cases of moderate or severe disease and only two cases of mild disease occurred in children vaccinated after exposure[348].

Transmission of VZV to HCWs has been reported frequently[349-357]; index cases (HCWs or patients) of outbreaks in some instances were found to be in the pre-rash phase of varicella[330,349,351]. Furthermore, transmission has occurred among patients and/or HCWs who had had no contact with the index case, providing evidence for airborne spread[356,358].

A report of a 1992 nosocomial varicella epidemic in a large Australian hospital described 20 documented cases in staff, nine of these resulting from direct exposure to an index patient. A total of 1655.6 person-days of work were lost at an estimated cost of $18,000 (Australian)[353].

In a review of five unrelated HCW cases of varicella, each case had from 0 to 60 HCW and patient contacts. Thirty-nine percent of exposed persons (50) had negative or uncertain histories and were serologically tested; 10% were found to be negative. Screening HCWs with a negative history of chickenpox is an acceptable method of determining exclusion requirements among contacts[357].

Recommendations

Compliance with the recommendations for the components of an OH program outlined in Section A–1-4 is required in addition to the following specific recommendations for varicella.

2. Risk Control Measures

2.1 Risk Control Measures to Prevent HCW Exposure to or Infection with Varicella

2.1.1 *Engineering Controls*

OH should liaise with IC and Engineering/Physical Plant to ensure that negative pressure rooms are appropriately maintained and are available for patients suspected or known to have varicella[4,358,359]. **AII**

2.1.2 *Administrative Controls*

See Section A-2.1.2.

2.1.3 *OH Work Practices*

OH should document the HCW immune status at the preplacement examination[7,331]. **AIII**

OH should consider HCWs to be immune if there is a self-reported history of varicella or herpes zoster, physician-diagnosed varicella or herpes zoster, documentation of VZV IgG, or if two doses of live varicella vaccine have been given at least 1 month apart (for adults)[7,331,332,337]. **AIII**

OH should screen HCWs without a definite history of VZV for antibody to varicella-zoster[7,332,337]. **AIII**

OH should ensure that there is immunity to VZV in newly hired HCWs within 2 months of hiring and in current HCWs, starting with those who work in high-risk settings[7]. **AIII**

OH should ensure that by the year 2003 all HCWs have immunity to varicella or an acceptable medical contraindication to vaccination[7]. **AIII**

OH should immunize all susceptible HCWs with two doses of live varicella vaccine given at least 1 month apart (for adults), unless there are contraindications[7,332]. **AI**

OH should not vaccinate susceptible female HCWs during pregnancy[7,332]. **AIII**

OH should advise female HCWs of child-bearing age to avoid pregnancy for 1 month after immunization[332]. **AIII**

OH should refer susceptible immunocompromised HCWs to their physician for consideration of immunization[7,332]. **AIII**

OH should not perform postvaccine serologic procedures on immunized HCWs[7,332]. **AII**

There is no recommendation for booster doses of vaccine[7,332,337]. **C**

OH should inform the susceptible HCW and his or her manager that the HCW should not care for patients suspected or confirmed to have VZV[4]. **AIII**

OH should ensure that HCWs who are susceptible do not work with patients suspected or confirmed to have VZV[4]. **AIII**

2.1.4 *Personal Protective Equipment*

OH should ensure that HCWs who are susceptible but who absolutely must enter the room of a patient for whom Airborne Precautions are in place for suspected or confirmed varicella are provided with an appropriate mask for respiratory protection against the virus. The mask should meet or exceed the following recommendations:

- filters particles 1 μm (one micron) in size,
- has a 95% filter efficiency tested in the unloaded state,
- provides a tight seal (< 10% facial seal leak)[4]. **BIII**

OH should advise HCWs to wear gloves when they enter the room of a patient for whom Contact Precautions are in place for suspected or confirmed varicella and to wear a gown if direct contact with the patient or environmental surfaces is likely[4]. **BII**

OH should advise immune HCWs that masks are not required[4]. **BIII**

2.2 Risk Control Measures to Manage HCWs Exposed to or Infected with Varicella

2.2.1 *Assessment of HCW Exposure to Varicella*

2.2.1.1 Method of Transmission of Varicella

Varicella is transmitted to a susceptible individual by inhalation of airborne virus, or by direct or indirect contact of oral or nasal mucous membranes with vesicle fluid or respiratory secretions from an infected individual.

Transmission of vaccine virus is rare[332].

2.2.1.2 Definition of Occupational Exposure to Varicella

OH should define exposure as a susceptible HCW inhaling airborne virus from an infectious patient, having face-to-face contact with an infectious patient, spending 1 hour in the room with an infectious patient, or having direct or indirect contact through the oral or nasal mucous membranes with vesicle fluid or respiratory secretions from an infectious patient 2 days before onset of symptoms and until all lesions have crusted over. **AIII**

2.2.2 *Assessment of Source of HCW Exposure*

In collaboration with IC, OH should confirm the diagnosis of the source and assess the potential for communicability at the time of the HCW exposure. **AIII**

2.2.2.1 Communicability of Source

The incubation period is 10 to 21 days; however, this may be extended to 28 days if VZIG is given. The virus is potentially communicable in the 2 days before symptoms appear[4], and the period of communicability continues until all lesions are dry and crusted[4]. Contagiousness may be prolonged in those with altered immunity[23].

2.2.3 *Criteria to Confirm the Diagnosis of Varicella*

Clinical illness – generalized pruritic vesicular rash with mild fever and systemic symptoms; pneumonia, hepatitis or encephalitis may be complications

With or **Without** laboratory evidence – IgM antibody positive for varicella-zoster; four-fold rise in varicella-zoster IgG antibody; viral culture of an appropriate clinical specimen positive for varicella-zoster

Or – compatible clinical illness in a HCW who is epidemiologically linked to a case confirmed in the previous 21 days

2.2.4 *OH Work Practices to Manage HCWs Exposed to or Infected with Varicella*

2.2.4.1 HCWs Exposed to Varicella

OH should determine the immune status of the exposed HCW. If it is unknown, or if only one dose of vaccine has been received, test for IgG antibody[7,332]. **AIII**

OH should consider the HCW to be immune if there is a self-reported history of varicella or herpes zoster, or evidence of physician-diagnosed varicella or herpes zoster, documentation of VZV IgG, or two doses of live varicella vaccine given at least 1 month apart (for adults)[7,331,332,337]. **AIII**

OH should consider immunizing, within 3 days of exposure, susceptible, exposed HCWs who are not pregnant[7,337]. **AIII**

OH should refer exposed, susceptible HCWs who are not candidates for postexposure immunization with varicella vaccine for clinical management, which may include prophylaxis with an antiviral. **AIII**

OH should refer exposed, susceptible HCWs who are immunocompromised or pregnant for clinical management, which should include VZIG given within 96 hours of exposure[8,24,78,336]. **AIII**

OH should exclude susceptible, exposed HCWs from work from day 8 after the first exposure until day 21 after the last exposure (extend the exclusion until day 28 if VZIG is given)[4,8]. **AIII**

2.2.4.2 HCWs Symptomatic or Infected with Varicella

OH should refer HCWs who are symptomatic or infected with varicella for confirmation of diagnosis and for clinical management, which should include early therapy with an antiviral[8,360]. **AI**

OH should exclude HCWs with varicella from work until all lesions are dry and crusted[4] and no new lesions are forming. **AIII**

OH should not exclude HCWs with a localized, postimmunization varicella-like rash that can be covered with an occlusive dressing[332]. **BIII**

OH should exclude HCWs with a postimmunization varicella-like rash if the rash cannot be covered and if the HCWs are involved in the care of high-risk patients, e.g. immunocompromised and newborn patients, for the duration of the rash[7,332]. **BIII**

OH should inform IC as soon as possible of a suspected or confirmed case. **AIII**

2.2.4.3 OH Management of Varicella Outbreak

OH should consider the possibility of an outbreak if more than one HCW on the same unit meet the criteria for diagnosis. **AIII**

OH should liaise with IC and public health authorities if an outbreak is suspected. **AIII**

2.2.4.4 OH Reporting to Public Health Authorities of HCWs with Varicella

OH should report a case or a suspected or confirmed outbreak to public health authorities as required by legislation.

3. Education of HCWs about Prevention and Management of Exposure to or Infection with Varicella

OH should design education specific to varicella according to the recommendations outlined in Section A-3, to include the following information:

- immunization and prophylaxis recommendations,
- the need to inform OH promptly if varicella occurs, or if the HCW is susceptible and exposed to VZV in the workplace or community,
- avoidance of exposure to high-risk individuals while infectious, e.g. immunocompromised or susceptible pregnant individuals in the community, because of the serious consequences of disease,

- the need to inform OH of postimmunization varicella-like rash or adverse reactions. **AIII**

4. Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infection with Varicella

OH should refer to Section A-4 to develop an evaluation program specific to varicella, including

- preplacement immunity seroprevalence,
- rates of single versus outbreak cases,
- rates or number of cases requiring postexposure intervention (vaccine or VZIG),
- number requiring antiviral treatment,
- number of employees who received pre-exposure vaccine and did not develop varicella after exposure,
- number of adverse reactions to vaccine (describe symptoms),
- number requiring work restrictions,
- number of secondary cases,
- number of days of lost work related to varicella exposures and infections,
- surveillance as outlined in *Proceedings of the 1999 National Varicella Consensus Conference*[7].

AIII

B. Herpes Zoster (Shingles)

1. Risk Assessment for Transmission of Herpes Zoster to HCWs

1.1 Clinical Significance of Herpes Zoster

Herpes zoster results from dermatomal reactivation of VZV that has been dormant in the dorsal root ganglion of the spinal cord following primary infection with chickenpox. Approximately 15% of the population will experience herpes zoster during their lifetime[23,331]. Herpes zoster may disseminate in immunocompromised patients resulting in lesions outside the primary dermatome or visceral complications[24].

1.2 Evidence of Exposure/Transmission of Herpes Zoster

Varicella can be transmitted from the lesions of individuals who have herpes zoster to varicella-susceptible contacts. This VZV transmission will result in chickenpox (varicella) infection, not shingles (herpes zoster), in susceptible individuals[336].

The likelihood of transmission from herpes zoster is much less than that from primary varicella[336]. The disseminated form of herpes zoster is presumed to be more communicable because of the larger number of lesions and, thus, infectious virus particles[361].

In a report investigating VZV aerosols from localized herpes zoster in immunocompromised patients it was concluded that viral shedding originated from skin lesions, not a respiratory source[359].

HCWs with herpes zoster in small, non-exposed areas that are covered do not pose a substantial risk to patients or HCWs[362].

Inappropriate infection control practice for a patient known to have localized herpes zoster has resulted in varicella infection in two nurses. As a result, 25 susceptible HCWs were excluded from work and 90 patients were exposed. Although no secondary cases occurred in exposed patients or HCWs the cost to the hospital for paid leave of HCWs was $10,941.00 (1981 United States dollars)[363].

Three of six susceptible HCWs developed chickenpox following exposure to localized herpes zoster. Two HCWs had no contact with the source case. The authors reported that air tracer studies indicated that the infections probably occurred by "airborne spread"[361].

Recommendations

Compliance with recommendations for the components of an OH program outlined in section A–1-4 is required in addition to the following recommendations specific to herpes zoster.

2. Risk Control Measures

2.1 Risk Control Measures to Prevent HCW Exposure to or Infection with Herpes Zoster

2.1.1 *Engineering Controls*

OH should liaise with IC and Engineering/Physical Plant to ensure that negative pressure rooms are appropriately maintained and are available for patients with herpes zoster[4,358,359] as outlined by the conditions (1) to (3) in 2.1.4 below. **AII**

2.1.2 *Administrative Controls*

See Section A-2.1.2.

2.1.3 *OH Work Practices*

See varicella on p. 128.

2.1.4 *Personal Protective Equipment*

OH should ensure that appropriate masks for respiratory protection against varicella are provided to HCWs who are susceptible but who absolutely must enter the room of a patient for whom Airborne Precautions are in place for (1) suspected or confirmed disseminated herpes zoster, (2) extensive, localized herpes zoster that cannot be covered, in pediatric settings or settings where there are susceptible immunocompromised patients, or (3) localized herpes zoster (even if covered) when

the patient is immunocompromised, until 24 hours of antiviral treatment. The mask should meet or exceed the following recommendations:

- filters particles 1 μm (one micron) in size,
- has a 95% filter efficiency tested in the unloaded state, and
- provides a tight seal (< 10% facial seal leak)[4]. **BIII**

OH should advise HCWs to wear gloves when entering the room of a patient for whom Contact Precautions are in place for the same conditions (1) to (3) as above; gowns should be worn if direct contact with the patient or environmental surfaces is likely[4]. **BII**

OH should advise immune HCWs that masks are not required[4]. **BIII**

2.2 Risk Control Measures to Manage HCWs Exposed to or Infected with Herpes Zoster

2.2.1 *Assessment of HCW Exposure to Herpes Zoster*

2.2.1.1 Method of Transmission of Herpes Zoster

The method of transmission of localized herpes zoster is by direct or indirect contact of oral or nasal mucous membranes with infectious vesicle fluid; or, rarely, by inhalation of aerosolized virus from shedding lesions. Transmission causes varicella in susceptible individuals.

In addition, the method of transmission of disseminated herpes zoster may be by the airborne route, presumably because viral shedding is very high.

2.2.1.2 Definition of Occupational Exposure to Herpes Zoster

OH should define exposure as direct or indirect contact of oral or nasal mucous membranes of a susceptible HCW with the vesicle fluid of an infectious patient; additionally, exposure to disseminated herpes zoster is defined as a susceptible HCW being in an enclosed airspace, e.g. in the same room, with an infectious patient or having face-to-face contact with an infectious patient. **AIII**

2.2.2 *Assessment of Source of HCW Exposure*

In collaboration with IC, OH should confirm the diagnosis of the source and assess the potential for communicability at the time of the HCW exposure. **AIII**

2.2.2.1 Communicability of the Source

The incubation period is the same as for varicella, i.e. 10 to 21 days. The period of communicability continues until the lesions crust over.

2.2.3 *Criteria to Confirm the Diagnosis of Herpes Zoster*

Clinical illness – vesicular skin lesion(s) either localized to a sensory dermatome or disseminated, and sometimes accompanied by pain in the area of eruption

With or **Without** laboratory evidence – direct fluorescent antibody positive for varicella-zoster; viral culture of vesicle fluid positive for varicella-zoster

2.2.4 *OH Work Practices to Manage HCWs Exposed to or Infected with Herpes Zoster*

2.2.4.1 HCWs Exposed to Herpes Zoster

OH should determine the immune status of the exposed HCW. If it is unknown, or if only one dose of vaccine has been received, test for IgG antibody[7,332]. **AIII**

OH should consider HCWs to be immune who have a self-reported history of varicella or herpes zoster, or evidence of physician-diagnosed varicella or herpes zoster, documentation of VZV IgG, or two doses of vaccine given at least 1 month apart[7,332]. **AIII**

OH should consider immunizing, within 3 days of exposure, susceptible, exposed HCWs who are not pregnant[7,337]. **AIII**

OH should refer exposed, susceptible HCWs who are not candidates for postexposure immunization with varicella vaccine for clinical management, which may include prophylaxis with an antiviral. **AIII**

OH should refer exposed, susceptible HCWs who are immunocompromised or pregnant for clinical management, which should include VZIG within 96 hours of exposure[8,24]. **AIII**

OH should exclude exposed, susceptible HCWs from work from day 8 after the first exposure until day 21 after the last exposure (extend the exclusion until day 28), if VZIG is given[4,8]. **AIII**

2.2.4.2 HCWs Symptomatic or Infected with Herpes Zoster

OH should advise HCWs with localized lesions to cover the lesions with an occlusive dressing and, where possible, with clothing when at work[78,362]. **AIII**

As soon as possible and before 48 hours, OH should refer HCWs with localized or disseminated herpes zoster for confirmation of diagnosis and for clinical management, which should include early therapy with an antiviral[8,360]. **AI**

OH should exclude HCWs with disseminated zoster from work until all lesions have dried and crusted[4]. **AIII**

OH should exclude HCWs with localized lesions from work with high-risk patients, i.e. neonates, susceptible pregnant women, and the immunocompromised until all lesions have dried and crusted[78,362]. **AIII**

OH should exclude HCWs with localized lesions from work with patients not at high risk only when lesions cannot be covered with an occlusive dressing or clothing and/or when handwashing is compromised, until all lesions have dried and crusted[78]. **AIII**

OH should exclude immunocompromised HCWs with localized herpes zoster from direct patient care until all lesions have dried and crusted[78]. **AIII**

OH should inform IC of a suspected or confirmed case of disseminated or uncovered localized herpes zoster as soon as possible. **AIII**

2.2.4.3 OH Management of Varicella Zoster Outbreak

OH should consider the possibility of an outbreak if more than one HCW on the same unit meet the criteria for diagnosis for either varicella or herpes zoster. **AIII**

OH should liaise with IC and public health authorities if an outbreak of varicella is suspected to be related to herpes zoster case(s). **AIII**

2.2.4.4 OH Reporting to Public Health Authorities of HCWs with Herpes Zoster

There is no reporting requirement for herpes zoster.

3. Education of HCWs about Prevention and Management of Exposure to or Infection with Herpes Zoster

OH should design education specific to herpes zoster according to the recommendations outlined in Section A-3 and including the following information:

- the advantages of vaccine,
- the need to inform OH promptly if herpes zoster occurs,
- that herpes zoster is not as infectious as varicella,
- the need to cover lesions with an occlusive dressing and clothing while working,
- the need for referral for clinical management if disseminated or localized lesions are present,
- that herpes zoster is a reactivation of latent varicella virus[364],
- the risk of serious consequences if transmitted to high-risk individuals, e.g. immunocompromised or susceptible, pregnant individuals, and the need to avoid exposure of them. **AIII**

4. Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infection with Herpes Zoster

OH should include herpes zoster in the varicella evaluation program. **AIII**

Viral Hemorrhagic Fever (VHF)

Includes Crimean-Congo hemorrhagic fever, Dengue fever, Ebola, Lassa fever, Marburg virus

Administration should ensure that OH has developed policies and procedures for the prevention and management of HCW exposure to and/or infection with VHF, according to the *Canadian Contingency Plan for Viral Hemorrhagic Fevers and Other Related Diseases, 1997*[13] and related provincial/territorial recommendations.

– Section B –
Recommendations for Diseases of Significance to Occupational Health

– Part II –
Grouped Diseases/Infections

Hepatitis A Virus (HAV) and Hepatitis E Virus (HEV)

1. Risk Assessment for Transmission of HAV and HEV to HCWs

1.1 Clinical Significance of HAV and HEV to HCWs

Hepatitis A is an acute, self-limited illness characterized by fever, malaise, jaundice, anorexia, and nausea. Usually, the duration of illness is several weeks, but there may be prolonged or relapsing disease lasting as long as 6 months. Chronic infection does not occur, and fulminating hepatitis is uncommon[24], but when it does occur it appears more frequently in adults.

Hepatitis E is an acute illness with a clinical course similar to that of hepatitis A[23], including jaundice, malaise, anorexia, fever, abdominal pain, and arthralgia[24].

The case fatality rate of hepatitis E is less than that of hepatitis A except when HEV infection occurs in pregnant women; the case fatality rate may reach 20% among those infected during the third trimester of pregnancy. Hepatitis E cases occur only in travellers returning from countries where HEV is endemic, e.g. India, Mexico[23].

1.2 Evidence of Exposure/Transmission of HAV and HEV

In Canada, between 1,000 and 3,000 cases of HAV infection are reported annually. As of 1994, the reported incidence rates per 100,000 population have varied from 4.4 to 11.2[365].

Contaminated hands and environmental surfaces are important in the spread of HAV[366].

Although the source of infection was unknown in 44% of the clinical cases of HAV reported to the CDC during 1990-92, the most commonly reported risk factor for HAV infection was personal contact with a case[24].

HAV has not been reported to be transmitted by needlestick injury[141].

In a study to investigate the cost-effectiveness of HAV vaccination in medical students, the authors stated that routine vaccination would not result in a net cost saving if the risk of HAV to HCWs is the same as that to the general population[367]. They noted that the incidence of HAV infection among HCWs is not known and may be higher than among the general population because of HCWs' contact with ill and contagious patients. Also, rates in the general population are determined by passive reporting, and many cases are unreported. Because the incidence of hepatitis A in the past 2 decades has decreased, there is an increase

in susceptibility in adults, and future HCWs will be more susceptible. The authors concluded that routine vaccination may not be warranted at this time, but that more studies are needed.

Serologic surveys have not found an increased prevalence of HAV infection among HCWs as compared with control populations. However, occupational transmission of HAV has been reported[112,113,368-373].

Transmission of HAV to HCWs occurred on two occasions when HCWs cared for infants not known to have acquired HAV from blood transfusions[112,369]. One outbreak, in which risk factors for infection were not documented[112], affected 15 nurses. In the second outbreak, 22 nurses and 8 other HCWs were infected. Breaks in infection control procedures and, possibly, prolonged HAV excretion in infected infants propagated the epidemic[369].

A case-control study of an HAV outbreak on a burn unit, affecting 11 HCWs, implicated eating on the unit as the single most important risk factor for infection. Inadequate hand-washing and subsequent oral contamination were identified as the cause of the outbreak, which originated with burn patients (a father and son) who were not known to be incubating HAV on admission[113].

A recent outbreak of HAV infection in an adult facility occurred following the admission of a homeless alcoholic patient who was not known to be incubating HAV. The outbreak continued for 11 months, affecting eight nurses, four patients, and two household contacts. Factors contributing to transmission included few patient toilets, overcrowding in an old facility, poor personal hygiene, the behaviour of the index patient, nursing inattention to enteric precautions, and nurses eating meals on the ward. The outbreak appeared to stop with a program of mass vaccination[368].

There is no evidence that HCWs are at increased risk of HAV infection[8,365] when standard infection control techniques are exercised[374].

It has not been determined whether vaccination of foodhandlers would be effective in reducing foodborne outbreaks[365,374].

In the U.S. and most industrialized countries, HEV cases have been documented only among travellers returning from HEV-endemic countries[23,24].

Recommendations

Compliance with the recommendations for the components of an OH program outlined in Section A–1-4 is required in addition to the following specific recommendations for HAV and HEV.

2. Risk Control Measures

2.1 Risk Control Measures to Prevent HCW Exposure to or Infection with HAV or HEV

2.1.1 *Engineering Controls*

See Section A-2.1.1.

2.1.2 *Administrative Controls*

See Section A- 2.1.2.

2.1.3 *OH Work Practices*

Routine HAV immunization for HCWs, including foodhandlers, is not currently recommended[8,365]. **AIII**

OH should consider immunization of HCWs who work in institutions for the developmentally challenged, where there is an ongoing problem with HAV transmission[8]. **AIII**

2.1.4 *Personal Protective Equipment*

OH should advise HCWs to wear gloves when entering the room of a pediatric patient for whom Contact Precautions are in place for suspected or confirmed HAV or HEV, and to wear a gown if direct contact with patient or environmental surfaces is likely. Contact Precautions may be required for incontinent adults if feces cannot be contained or for adults with poor hygiene who contaminate their environment[4]. **BII**

2.2 Risk Control Measures to Manage HCWs Exposed to or Infected with HAV or HEV

2.2.1 *Assessment of HCW Exposure to HAV or HEV*

2.2.1.1 Method of Transmission of HAV or HEV

HAV and HEV are transmitted by direct or indirect ingestion of infectious feces or by ingestion of contaminated food or water.

2.2.1.2 Definition of Occupational Exposure to HAV or HEV

OH should define exposure as a susceptible person having direct or indirect oral contact with infectious feces; exposure many also occur with ingestion of contaminated food or water. **AIII**

2.2.2 *Assessment of Source of HCW Exposure*

In collaboration with IC, OH should confirm the diagnosis of the source and assess the potential for communicability at the time of HCW exposure. **AIII**

2.2.2.1 Communicability of Source

The incubation period for HAV is 15 to 50 days. The period of communicability is 2 weeks before to 1 week after the onset of symptoms, except for the newborn, in whom fecal shedding is prolonged and the period of communicability may therefore be longer[4].

The incubation period for HEV is 15 to 60 days. The period of communicability is unknown, but fecal shedding occurs for at least 2 weeks[24].

2.2.3 *Criteria to Confirm the Diagnosis of HAV or HEV*

HAV clinical illness – fever, malaise, jaundice, anorexia, nausea

Plus laboratory evidence – IgM antibody positive for HAV

Or – compatible clinical illness in a HCW who is epidemiologically linked to a case confirmed in the previous 6 weeks

HEV clinical illness – jaundice, malaise, anorexia, fever, abdominal pain, arthralgia

Plus laboratory evidence – IgG antibody positive for HEV (available in some reference laboratories)

2.2.4 *OH Work Practices to Manage HCWs Exposed to or Infected with HAV or HEV*

2.2.4.1 HCWs Exposed to HAV or HEV

OH should consider HCWs with evidence of hepatitis A immunization or documentation of HAV IgG to be immune to HAV[8]. **AIII**

OH should refer susceptible HCWs exposed to HAV for clinical management, which may include administration of immune globulin (IG) within 2 weeks of exposure[8]. **AIII**

There is no recommendation for postexposure HAV immunization[8,365].

OH should refer pregnant, susceptible HCWs exposed to HEV to their physicians for clinical management. **BIII**

There are no modifications of work practices or work restrictions for susceptible HCWs exposed to HAV or HEV[4].

2.2.4.2 HCWs Symptomatic or Infected with HAV or HEV

OH should refer HCWs who are symptomatic or infected with HAV or HEV for confirmation of diagnosis and for clinical management, which should include laboratory investigation. **AIII**

OH should exclude HCWs infected with HAV or HEV from handling food and from contact with patients and their environment until 7 days after the onset of jaundice or other clinical symptoms[78] or as required by public health authorities. **AIII**

OH should inform IC as soon as possible of a suspected or confirmed case. **AIII**

2.2.4.3 OH Management of HAV or HEV Outbreak

OH should consider the possibility of an outbreak if more than one HCW on the same unit meet the criteria for diagnosis. **AIII**

OH should liaise with IC and public health authorities if an outbreak is suspected. **AIII**

2.2.4.4 OH Reporting to Public Health Authorities of HCWs with HAV or HEV

OH should report a case and a suspected or confirmed outbreak to public health authorities as required by legislation.

3. Education of HCWs about Prevention and Management of Exposure to or Infection with HAV or HEV

OH should design education specific to HAV and HEV according to the recommendations outlined in Section A–3 and including information on safe foodhandling practices and the requirement not to share patient food, chocolates, or beverages. **AIII**

4. Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infection with HAV and HEV

OH should refer to Section A-4 to develop an evaluation program specific to HAV and HEV, including

- the number of exposed/infected HCWs,
- the number of HCWs that received prophylaxis,
- time lost due to infections. **AIII**

Gastroenteric Infections

The following information pertains to adenoviruses, caliciviruses (Norwalk), Campylobacter, *Clostridium difficile,* Cryptosporidium, *Entamoeba histolytica*, *Escherichia coli* - verotoxigenic, Giardia, rotavirus, Salmonella (non-typhi), Shigella, small round enteric viruses, and undiagnosed diarrheal illnesses.

Please refer to page 142 for Hepatitis A and Hepatitis E, and page 92 for *Salmonella typhi*.

1. Risk Assessment for Transmission of Gastroenteric Infections to HCWs

1.1 Clinical Significance of Gastroenteric Infections

Bacteria, viruses, protozoa, and helminths can cause gastroenteric infections in human beings.

Gastroenteric viruses have been recognized as major human pathogens only over the past 2 decades and include rotaviruses, adenoviruses, caliciviruses and viruses having a coronavirus-like morphology. Illness may involve simultaneous infection by two or more organisms.

Gastroenteric infections present with variable severity, ranging from no symptoms to such symptoms as diarrhea, abdominal pain, malaise, fever, and nausea and vomiting. Some infections are accompanied by bloody diarrhea, systemic complications, or extra-intestinal syndromes such as hemolytic uremic syndrome. These infections are often treated symptomatically with no attempt to identify the causative organism.

1.2 Evidence of Exposure/Transmission of Gastroenteric Infections

Infection with verotoxin-producing *E. coli* is a significant cause of morbidity in Canada, which has high rates compared with most countries[375]. The reported annual incidence reached a peak of 7.0 per 100,000 in 1991; since then it has declined and remains at approximately 4 per 100,000[376].

An intern developed acute diarrhea and serologic evidence of cryptosporidiosis after caring for a patient with chronic infection. One week after the onset of her diarrhea the intern's spouse also developed a diarrheal illness with subsequent Cryptosporidium antibody titres. Thirty-one percent of exposed HCWs (8/26) were found to have positive antibody titres.

HCWs with significant increased exposure to the patient's infectious feces were more likely to have positive titres. The report noted that glove, gown, and masks were not routinely used during daily care[377].

A healthy nurse on an intensive care unit acquired cryptosporidiosis from a bone-marrow transplant recipient. The nurse recalled that one of the fingers of her glove broke while she was providing care; no other unprotected contact was reported[378].

E. coli O157:H7 affected 18 of 137 HCWs and 55 of 169 residents in a nursing home outbreak. Hemolytic uremic syndrome occurred in 22% of affected residents (8 of 9 cases were fatal). There were no complications or deaths among the affected members of staff. The source of the illness was thought to be foodborne, while subsequent cases were spread by person-to-person contact[379].

A Norwalk-like agent was responsible for a hospital-wide gastroenteritis outbreak affecting 27% of HCWs (635 of 2,379). The attack rate was greatest for those working in the Emergency Department, at 69%. The authors hypothesized that the infectious agent became airborne as a result of explosive diarrhea or explosive vomiting, or by movement of contaminated laundry. Subsequently, the airborne particles may have been inhaled and swallowed[380].

In a nursing home outbreak, salmonella was transmitted to 8 HCWs (3 of whom were laundry staff). The authors noted that the risk for transmission included inconsistent glove use by laundry workers handling grossly soiled linen and laundry workers eating in a "dirty room" that was not regularly cleaned by housekeeping staff[381].

Shigella was transmitted to 3 of 32 HCWs (10%) providing care to an infant with undiagnosed shigella. The infant probably acquired the infection from the mother during birth[382].

Recommendations

Compliance with the recommendations for the components of an OH program outlined in Section A–1-4 is required in addition to the following specific recommendations for gastroenteric infections.

2. Risk Control Measures

2.1 Risk Control Measures to Prevent HCW Exposure to or Infection with Gastroenteric Infections

2.1.1 *Engineering Controls*

See. Section A-2.1.1.

2.1.2 *Administrative Controls*

See Section A-2.1.2.

2.1.3 *OH Work Practices*

OH should advise HCWs not to eat food or consume beverages in direct patient care areas. **AIII**

OH should provide information to HCWs regarding the possibility that special attention to environmental cleaning may be required during *C. difficile* outbreaks[4]. **AIII**

2.1.4 *Personal Protective Equipment*

OH should advise HCWs to wear gloves when entering the single room or designated bedspace in a shared room of a pediatric patient for whom Contact Precautions are in place for suspected or confirmed gastroenteric infections, and to wear a gown if direct contact with the patient or environmental surfaces is likely. Contact Precautions may be required for incontinent adults if feces cannot be contained or for adults with poor hygiene who contaminate their environment[4]. **BII**

2.2 Risk Control Measures to Manage HCWs Exposed to or Infected with Gastroenteric Infections

2.2.1 *Assessment of HCW Exposure to Gastroenteric Infections*

2.2.1.1 Method of Transmission of Gastroenteric Infections

Gastroenteric infections are transmitted by direct or indirect ingestion of infectious feces or by ingestion of contaminated food or water. Airborne transmission has been suggested in some Norwalk-like virus outbreaks[380,383].

2.2.1.2 Definition of Occupational Exposure to Gastroenteric Infections

OH should define exposure as having direct or indirect oral contact with infectious feces; exposure may also occur with ingestion of contaminated food or water. **AIII**

2.2.2 *Assessment of Source of HCW Exposure*

OH should confirm the diagnosis of the source and assess the potential for communicability at the time of HCW exposure. **AIII**

2.2.2.1 Communicability of Source

The incubation period and period of communicability vary among organisms and can be found in Health Canada's *Routine Practices and Additional Precautions for Preventing the Transmission of Infection in Health Care*[4].

2.2.3 *Criteria to Confirm the Diagnosis of Gastroenteric Infections*

Clinical illness – diarrhea, abdominal pain, malaise, fever, anorexia, nausea and vomiting; organism-specific manifestations e.g. hemolytic uremic syndrome (verotoxigenic *E. coli*), pseudomembranous colitis (*C. difficile*)

Plus laboratory evidence – viral or bacterial culture or examination for parasites of an appropriate clinical specimen positive for a known gastroenteric pathogen; antigen detection assay of an appropriate clinical specimen positive for a known gastroenteric pathogen

Or – compatible clinical illness in a HCW who is epidemiologically linked to a case confirmed within the appropriate incubation period

2.2.4 *OH Work Practices to Manage HCWs Exposed to or Infected with Gastroenteric Infections*

2.2.4.1 HCWs Exposed to Gastroenteric Infections

There are no modifications of work practices or work restrictions for HCWs exposed to gastroenteric infections.

2.2.4.2 HCWs Symptomatic or Infected with Gastroenteric Infection

OH should evaluate HCWs with evidence of infection, e.g. diarrhea or vomiting, and refer for clinical management as necessary. **AIII**

OH should refer HCWs with clinically significant diarrhea and/or vomiting for confirmation of diagnosis and for clinical management, which may include laboratory investigation and supportive therapy, i.e. maintaining hydration, control of nausea and diarrhea as indicated. Antibiotics are indicated for selected infections, e.g. bacillary dysentery caused by shigella. **AIII**

OH should exclude HCWs with vomiting or diarrhea from contact with patients and their environment and from food handling until stools have formed or as specified by public health regulations. **AIII**

OH should assess HCWs' fitness for work; evaluate for resolution of symptoms; assess for type of patient/work/physical setting, hygiene practices, and risk control measures that can be used; and establish a follow-up schedule. **AIII**

2.2.4.3 OH Management of Gastroenteric Infection Outbreak

OH should consider the possibility of an outbreak if more than one HCW on the same unit meet the criteria for diagnosis and appear linked epidemiologically to transmission. **AIII**

OH should liaise with IC and public health authorities if an outbreak is suspected. **AIII**

In consultation with IC, OH may modify work restrictions as necessary in outbreak situations. **AIII**

OH may consider limiting staff movement among affected and non-affected units during an outbreak situation. **BIII**

2.2.4.4 OH Reporting to Public Health Authorities of HCWs with Gastroenteric Infection

OH should report a case or a suspected or confirmed outbreak to public health authorities as required by legislation.

3. Education of HCWs about Prevention and Management of Exposure to or Infection with Gastroenteric Infections

OH should design education specific to gastrointestinal infections according to the recommendations outlined in Section A-3 and including

- safe foodhandling practices,
- the hazards of eating and drinking on patient care units,
- associated risks with some pets. **AIII**

4. Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infection with Gastroenteric Infections

OH should refer to Section A-4 to develop an evaluation program specific to gastroenteric infections. **AIII**

Respiratory Infections

The following information pertains to adenovirus, Mycoplasma, parainfluenza virus, respiratory syncytial virus (RSV), and rhinovirus.

Note: for information on influenza see page 52; for tuberculosis page 122; and for Streptococcus group A page 112.

1. Risk Assessment for Transmission of Respiratory Infections to HCWs

1.1 Clinical Significance of Respiratory Infections

Respiratory infections can present with variable severity, ranging from mild upper respiratory illness to pneumonia, and are caused by a variety of organisms. These infections are often treated symptomatically with no attempt to identify the causative organism.

HCWs are exposed to respiratory pathogens both in the community and in occupational settings; determining whether an infection is work related is often difficult and, perhaps, impossible.

1.2 Evidence of Exposure/Transmission of Respiratory Infections

RSV infection has repeatedly been acquired by HCWs, primarily those working in pediatrics[24]. Infection among HCWs can occur by self-inoculation of the eye or mouth with contaminated secretions[24] or hand contamination from contaminated objects. Transmission of the virus to patients on the hands of HCWs is the principal source of nosocomial infection[384,385].

The use of disposable eye-nose goggles has been associated with a significant decrease in patient and staff RSV infections[386]. The use of masks and goggles to enter the room of known RSV-infected patients has been associated with a significant reduction of illness in pediatric HCWs[387].

An outbreak of adenovirus infection in 28 of 61 long-term care residents in a pediatric care facility resulted in 11 patient deaths (case fatality rate of 39%) in an 8-week period; 23 HCWs had a similar illness. A higher rate of HCW illness was reported among those providing direct nursing care, especially pulmonary suctioning[388].

Mycoplasma pneumoniae was reported to be the cause of an outbreak in which 19 of 71 symptomatic HCWs showed seroconversion. Twenty-one percent of HCWs developed pneumonia. No patients were infected[389].

Parainfluenza was reported to infect 34% of nurses (18 of 52) in a neonatal intensive care unit. The authors reported that the reservoir was maintained in HCWs, who were then instrumental in exposing 24 susceptible children. Of the 17 neonates for whom culture was performed, six were positive for the virus; five of these were symptomatic, and three required ventilatory support[390].

Recommendations

Compliance with the recommendations for the components of an OH program outlined in Section A–1-4 is required in addition to the following specific recommendations for respiratory infections.

2. Risk Control Measures

2.1 Risk Control Measures to Prevent HCW Exposure to or Infection with Respiratory Infections

2.1.1 *Engineering Controls*

See Section A-2.1.1.

2.1.2 *Administrative Controls*

See Section A-2.1.2.

2.1.3 *OH Work Practices*

See Section A-2.1.3.

2.1.4 *Personal Protective Equipment*

OH should advise HCWs to wear gloves when entering the single room or designated bed space in a shared room of a pediatric patient for whom Contact Precautions are in place for suspected or confirmed respiratory infection, and to wear a gown if direct contact with the patient or environmental surfaces is likely[4]. **BII**

OH should advise HCWs to wear a procedure/surgical mask if within 1 m of a pediatric patient for whom Droplet Precautions are in place[4]. **BIII**

OH should advise HCWs to consider wearing eye protection (face shields or safety glasses/goggles) in addition to masks and gloves if they are within 1 m of a coughing child or if they are performing procedures that may result in coughing[386]. **BII**

2.2 Risk Control Measures to Manage HCWs Exposed to or Infected with Respiratory Infections

2.2.1 *Assessment of HCW Exposure to Respiratory Infections*

2.2.1.1 Method of Transmission of Respiratory Infections

Respiratory infections are transmitted primarily by droplet contact of the oral, nasal, or conjunctival mucous membranes with the oropharyngeal secretions of an infected individual and indirectly from hands and articles freshly soiled with discharges of the nose and throat of an acutely ill and coughing individual.

2.2.1.2 Definition of Occupational Exposure to Respiratory Infections

OH should define exposure as droplet or indirect contact of oral, nasal or conjunctival mucous membranes with infectious respiratory secretions. **AIII**

2.2.2 *Assessment of Source of HCW Exposure*

In collaboration with IC, OH should confirm the diagnosis of the source and assess the potential for communicability at the time of HCW exposure. **AIII**

2.2.2.1 Communicability of Source

The incubation period and period of communicability vary among organisms and can be found in Health Canada's *Routine Practices and Additional Precautions for Preventing the Transmission of Infection in Health Care*[4].

2.2.3 *Criteria to Confirm the Diagnosis of Respiratory Infections*

Clinical illness – fever, malaise, conjunctivitis, pharyngitis, headache, cough, bronchiolitis, bronchitis, pneumonia, croup, sinusitis, and otitis media

Plus laboratory evidence – viral culture of an appropriate clinical specimen positive for a known respiratory tract pathogen; antigen detection assay on an appropriate clinical specimen positive for a known respiratory pathogen; IgM antibody positive for a known respiratory pathogen; four-fold rise in IgG antibody for a known respiratory pathogen

Or – compatible clinical illness in a HCW who is epidemiologically linked to a case confirmed within the appropriate incubation time

2.2.4 *OH Work Practices to Manage HCWs Exposed to or Infected with Respiratory Infections*

2.2.4.1 HCWs Exposed to Respiratory Infections

There are no modifications of work practices or work restrictions for HCWs exposed to respiratory infections.

2.2.4.2 HCWs Symptomatic or Infected with Respiratory Infections

OH should evaluate HCWs with evidence of infection, e.g. sore throat, fever, pneumonia, conjunctivitis, and refer for clinical management as necessary. **AIII**

OH should assess HCWs with evidence of infection for fitness to work; evaluate for resolution of symptoms; assess for type of patient/work/physical setting, hygiene practices, and risk control measures that can be used; and establish a follow-up schedule. **BIII**

OH should minimize contact of HCWs who have acute respiratory infections with high-risk patients, i.e. pediatric patients with hemodynamically significant congenital heart disease or chronic lung disease, neonates, and immunocompromised patients. **BIII**

2.2.4.3 OH Management of Respiratory Infection Outbreak

OH should consider the possibility of an outbreak if more than one HCW on the same unit meet the criteria for diagnosis and appear linked epidemiologically to transmission. **AIII**

In consultation with IC, OH may modify work restrictions as necessary during outbreaks. **AIII**

OH should liaise with IC and public health authorities if an outbreak is suspected. **AIII**

2.2.4.4 OH Reporting to Public Health Authorities of HCWs with Respiratory Infection

There is no requirement for reporting a single case; report a suspected or confirmed outbreak to public health authorities as required by legislation.

3. Education of HCWs about Prevention and Management of Exposure to or Infection with Respiratory Infections

OH should design education specific to respiratory infections according to Section A-3. **AIII**

4. Evaluation of the OH Program to Prevent and Manage HCW Exposure to or Infection with Respiratory Infections

OH should refer to Section A-4 to develop an evaluation program specific to respiratory infections. **AIII**

Bloodborne Pathogens (Hepatitis B Virus [HBV], Hepatitis C Virus [HCV], or Human Immunodeficiency Virus [HIV])

This section addresses occupational bloodborne pathogen exposures to HCWs caused by percutaneous injuries, contact with mucous membranes or non-intact skin, and bites. As with previous diseases in this manual, discussion continues regarding the risk assessment, control measures, education, and evaluation of the OH program with respect to potential or actual bloodborne pathogen infections. A detailed literature review on occupational injuries with potential for bloodborne pathogen exposure can be found in Appendix II, and the analysis of the 1-year surveillance data concerning HCWs exposed to bloodborne pathogens at Canadian hospital settings can be found in Appendix III. Health Canada has produced many documents on bloodborne pathogens and, as the reader is referred to the original document, the minimum information is repeated from the following:

- *Preventing the Transmission of Bloodborne Pathogens in Health Care and Public Services Settings*[11]
- *An Integrated Protocol to Manage Health Care Workers Exposed to Bloodborne Pathogens*[12]
- *Proceedings of the Consensus Conference on Infected Health Care Workers: Risk for Transmission of Bloodborne Pathogens*[9]
- *Guidelines and Recommendations on the Prevention and Control of Hepatitis C*[391]
- *Hepatitis C – Prevention and Control: A Public Health Consensus*[6]
- *A National Consensus on Guidelines for Establishment of a Post-Exposure Notification Protocol for Emergency Responders*[19]
- *Proceedings of a National Symposium on Risk and Prevention of Infectious Diseases for Emergency Response Personnel*[20]

1. Risk Assessment for Transmission of Bloodborne Pathogens to HCWs

• Risk Assessment of Undefined Bloodborne Pathogens

1.1 Clinical Significance of Undefined Bloodborne Pathogens: HBV, HCV or HIV

Bloodborne pathogens are present in the blood and body fluids of some individuals receiving health care and may be transmitted to HCWs via certain types of exposure. Patients with

HBV, HCV, or HIV infection may be known at the time of care. However, many infected individuals are asymptomatic, and their infectious status may be unknown. HBV, HCV, and HIV infections all have the potential for a serious adverse outcome, and handling infected blood and body fluids or contaminated sharp equipment is a feature of health care. Therefore, while the risk of occupational exposure and subsequent seroconversion to a bloodborne pathogen is not encountered frequently, the risk is real.

Determinants of occupational transmission of a bloodborne pathogen include the following:

- the risk of exposure to blood and body fluids[11,20],
- the prevalence of infection in the client population[11,20],
- the efficiency of transmission following a significant exposure to infected blood or body fluids, in part determined by the amount of virus circulating in the source and the type of injury[11,20,392-394],
- the effectiveness of the postexposure protocol[392,394-396],
- the immune status of the exposed person[8,392,393], and
- the control measures in place to prevent the exposure and transmission of infection to HCWs[11,48,101].

These factors are further affected by other variables related to the virus, equipment design, and work practices. The risk is not equal for all viruses, for all work practices, or for all HCWs.

1.2 Evidence of Exposure/Transmission of Undefined Bloodborne Pathogens

The most common cause of HCW occupational exposure to blood and body fluids is by a percutaneous (e.g. needlestick) injury. Studies indicate that of all percutaneous injuries, those involving a hollow-bore needle are responsible for 59% to 94% of HCW exposures to blood[76,106,394,395,397], whereas other sharp injuries, e.g. a cut with a sharp instrument or suture needle, account for only 8% to 10% of percutaneous injuries[395,397,398].

HCW exposure to blood and body fluids via mucous membranes accounts for 10% to 16% of occupational bloodborne pathogen exposures[76,397,398].

Thirteen percent of the Canadians who reported to the National Surveillance of Occupational Exposure to the Human Immunodeficiency Virus (HIV) had blood or body fluid exposures to non-intact skin[397].

The Occupational Safety and Health Administration of the U.S. Department of Labor estimates that 600,000 to 800,000 needlestick injuries occur to U.S. HCWs annually[399]. Most injuries are to nurses. This calculation is based on HCW injuries in participating hospitals and includes adjustments for a 39% non-reporting rate and for the 50% of HCWs who work outside the hospital.

According to the Association of Workers' Compensation Boards of Canada, in 1997 and 1998, 46 and 61 HCWs respectively received compensation for occupational lost time reported

to the Workers' Compensation Boards because of injuries with needles and syringes. The exposures did not result in disease or illness at the time of the report[400,401]. Fifteen HCWs in Canada in 1997 and 27 in 1998 received compensation for occupational lost time generally when some disease (type not specified) or illness resulted from needlestick injuries[400,401]. Registered nurses and nurse supervisors were the groups of employees most affected.

The risk of transmission of infection following an occupational exposure varies with each pathogen. See below for HBV, page 162 for HCV, and page 165 for HIV.

Transmission of bloodborne pathogens from the HCW to the patient are documented in *Proceedings of the Consensus Conference on Infected Health Care Workers: Risk for Transmission of Bloodborne Pathogens*[9,402,403].

• Risk Assessment of Hepatitis B Virus (HBV)

1.1 Clinical Significance of HBV

HBV causes a wide spectrum of manifestations, ranging from asymptomatic infection in about 50% of adults to subacute illness with nonspecific or extrahepatic symptoms, acute clinical hepatitis with jaundice, and fatal fulminating hepatitis[392]. Fulminating hepatitis is a rare consequence of primary HBV infection and, although occurring in < 1% of patients, has an 80% to 90% mortality rate[83,392].

Five percent to 10% of persons develop chronic hepatitis B infection and may have persistence of hepatitis B surface antigen (HBsAg). Forty percent of HBV carriers who have severe disease will develop cirrhosis. Cirrhosis is a precursor of hepatocellular carcinoma in later life[392].

HBsAg can be found in virtually all body secretions and excretions; however, only blood (and serum-derived fluids), saliva, semen, and vaginal fluids have been shown to be infectious[23].

The presence of hepatitis B "e" antigen (HBeAg) indicates high virus titre and higher infectivity. The risk of transmission of HBV to susceptible HCWs via a needlestick injury varies from 1% to 6% when HBeAg is absent[392,404] to 19% to 40% when it is present[392,404-406].

Because HBV may survive on environmental surfaces for more than a week, indirect exposure to HBV can occur via contaminated inanimate objects and appears to have been a factor in HBV outbreaks among patients and staff of hemodialysis units[23,404].

The risk of transmission of HBV is reduced by immunization against hepatitis B, which is 90% to 95% effective in immunocompetent working-age adults[8]. Immunization for HCWs began in Canada in 1982[407,408] and is recommended for those persons at increased risk of occupational infection, i.e. those exposed to blood, blood products, and bodily fluids that may contain the virus[8]. The use of plasma-derived hepatitis B vaccine was replaced by recombinant vaccine in Canada in 1987.

Routine booster doses of hepatitis B vaccine for HCWs are not necessary in an immunocompetent person, as the protection persists as a result of an anamnestic response that usually occurs within 2 weeks of re-exposure to the hepatitis B virus, much earlier than the disease incubation period of 45 days[8,409,410].

Compliance with recommendations for immunization is suboptimal. A Winnipeg study indicated that only 55% of high-risk university hospital staff had been immunized in 1990[411]. In a 1993 Montreal study of community service centres and home care, it was found that 51.5% of exposed health care workers, including nurses, home attendants, dentists, and physicians, were immunized against hepatitis B[412].

A 1995 Canadian survey of a stratified random sample of over 6,000 dentists indicated that 68% to 100% of respondents stated that their dental hygienists had received hepatitis B immunization and 46% to 100% of all other clinical staff were immunized[413]. Ninety-four percent of dentists reported that they had received hepatitis B immunization or had acquired immunity[414].

In 1994-95, the CDC surveyed 200 U.S. hospitals, which conducted an employee chart review of 25 randomly selected employees. The study indicated that 72% of nurses, 81% of phlebotomists/technicians, and 71% of physicians had received three doses of hepatitis B vaccine[415].

1.2 Evidence of Exposure/Transmission of HBV

The most common means of transmission of HBV are sexual or household contact with an infected person, perinatal transfer from mother to neonate, injection drug use, and nosocomial infection[23]. Contaminated transfusions are a rare cause of infections now that donated blood is routinely screened (1:63,000)[416].

There is evidence of transmission of hepatitis B from minute amounts of contaminated blood. In 1990 in a California diabetic clinic, patients who underwent capillary blood sampling by fingerstick with a spring-loaded lancet device were more likely to contract hepatitis B infection than those who did not. The platform was not changed after each use of the device, and hepatitis B was transmitted to 26 patients via sharing of the spring-loaded device between HBV-infected and HBV-susceptible patients. Patients with 20 or more fingersticks during their hospital stay were 8.4 times more likely to have acquired hepatitis B than those with six or fewer fingersticks[417].

In 1996, nine of 67 patients in an Ohio nursing home and 14 patients in a New York City hospital contracted hepatitis B associated with spring-loaded fingerstick devices to test for glucose levels[418]. In Ohio, the end-caps were not always changed, and in New York City used lancet caps may have been mixed with unused lancet caps. In addition, a pen-like lancet-holding device was shared and not cleaned between patients in New York.

Hepatitis B has been transmitted from a patient to a HCW, who transmitted hepatitis B to two patients and three other HCWs[95]; all six were HBeAg positive. The transmission may have occurred as a result of weeping from the exudative dermatitis of a respiratory

technologist who worked while symptomatic, never wore gloves, and reused a discarded syringe to flush the line when obtaining blood from an arterial catheter of a patient with hepatitis B.

HBV has been transmitted in an ocular exposure[419].

Although saliva does not often transmit hepatitis B, such transmission is possible. A teacher at a school for developmentally handicapped children was bitten and became infected when she removed some material from the mouth of a student during a choking episode. Two puncture wounds were noted on her finger. The student was in the acute phase of hepatitis B illness, and tests done on the saliva indicated that it was HbsAg positive and negative for occult blood[420].

In Canada, there were three cases of compensated occupational hepatitis (type not specified) in HCWs in 1998. Nurses and/or nursing supervisors were the health care professional group affected[401]. The area of work where the exposure occurred is unknown.

Studies also indicate that HCWs are at higher risk of hepatitis B infection compared with non-HCWs, and that the categories of HCWs having greatest exposure to bloodborne pathogens are at particularly high risk. Early studies compared the increased risk of hepatitis B infection in HCWs and non-HCWs rather than testing workers at the time of exposure and determining the number of occupational seroconversions. The studies indicated that HCWs, e.g. surgeons, nurses, pathologists, blood bank staff, and surgical house officers, had a 3 to 4 times increased risk of infection and that their risk increased with the number of years worked in health care, including hemodialysis, surgery, laboratory work, and emergency care. Their risk decreased if they were working in pediatric and rural hospitals[419].

The CDC estimated that 5,100 HCWs with frequent blood contacts developed hepatitis B due to their work in 1991[421]. In 1992, it estimated that 6,800 nonimmunized HCWs who worked in jobs with the potential for exposure to blood would become infected with HBV every year, 250 would be hospitalized as a result of acute complications, and approximately 100 would die from cirrhosis, liver cancer, or fulminating hepatitis[422].

As a result of the U.S. Occupational Safety and Health Administration bloodborne pathogen standard that requires employers to provide hepatitis B immunization, the number of health care workers who have been immunized has increased, and the incidence of hepatitis B disease in HCWs has declined dramatically. In a review of employee records, the CDC estimated that 400 new hepatitis B infections occurred in HCWs in 1995. Although the hepatitis B infections were not necessarily occupational ones, the incidence of HBV infections changed from 3 times higher to 5 times lower than that in the general population from 1983 to 1995[415].

A clinical trials nurse died from hepatitis B infection 20 years after being exposed to it while learning to draw blood in nursing school[423].

France reported 10 documented cases of occupational HBV infection in 1983, but this was reduced to one case by 1993 as a result of achieving a 94% hepatitis B immunization coverage of employees sampled from a university hospital; 92% of HCWs showed an adequate response rate[424].

Transmissions of bloodborne pathogens from the HCW to the patient are documented in *Proceedings of the Consensus Conference on Infected Health Care Workers: Risk for Transmission of Bloodborne Pathogens*[9,402,403].

• Risk Assessment of Hepatitis C Virus (HCV)

1.1 Clinical Significance of HCV

HCV is the primary cause of parenterally transmitted non-A non-B hepatitis. About 90% of initial infections are asymptomatic, and 50% to 80% will develop into chronic hepatitis C[23]. Fifteen percent to 25% of people with hepatitis C may recover[425]. Ten percent to 20% of those with chronic infection will develop cirrhosis, and primary hepatocellular carcinoma is 5 to 50 times higher in HCV antibody positive patients than in HCV antibody-negative patients[426].

Population-based studies in the U.S. indicate that 40% of chronic liver disease is HCV related, resulting in an estimated 8,000 to 10,000 deaths each year[427].

In Canada, the estimated prevalence of hepatitis C infection is 0.8%[6]. Two-thirds of people with hepatitis C infection in Canada have genotype 1[428]. Genotyping is an important factor for planning optimal treatment and has prognostic value regarding response to current hepatitis C treatment regimens[6].

Current laboratory technology to diagnose hepatitis C infection has limitations. However, the third generation serologic enzyme immunoassays in use now are highly sensitive and detect HCV antibody in 95% of infected persons[426]. They remain the test of choice for initial assessment of specimens. In countries such as Canada, which have a population with a low prevalence rate of HCV infection, the rate of false positivity of HCV is high[426] (can be greater than 50%[391]), and thus all positive results should be confirmed by a supplemental test[6,391]. Current laboratory technology cannot readily distinguish between acute and chronic infection except by detecting seroconversion with repeated testing over time. As well, there is no sero-marker for resolved infection. There may be a prolonged period between the onset of acute illness and seroconversion, causing laboratory results to be subject to the timing of the testing.

Antibody testing is unreliable in immunosuppressed patients, e.g. patients with hypogammaglobulinemia undergoing renal dialysis, organ transplant recipients, HIV-infected persons, and in those with severe chronic liver disease. Therefore, immunosuppressed patients with a negative anti-HCV result, but in whom HCV infection is suspected, should have HCV nucleic acid detection (HCV RNA) by PCR testing[6]. Positive RNA is indicative of the presence of the virus and infectivity. The HCV RNA titre is used to guide treatment[6] and is also used for

research projects. The presence of HCV RNA may be intermittent during the course of the disease[426]. A negative HCV PCR over time and normal liver enzymes may indicate resolved infection. The average interval between occupational exposure and seroconversion is 6 to 7 weeks but may vary from 2 to 26 weeks[426].

There is no immunization available against HCV at this time[425].

1.2 Evidence of Exposure/Transmission of HCV

The major means of transmission of hepatitis C is by injection drug use (60% to 70%)[6,429]. In 10% to 15% of all Canadians with hepatitis C, acquisition was due to transfusion of blood or blood products[6] before 1990 or receipt of blood-derived coagulation products before 1985[12]. The risk of transmission of HCV now that donated blood transfusions are routinely screened is about 1:103,000[6,416]. Sexual exposures may account for up to 20% of acute hepatitis C transmissions in the community; two-thirds of community exposures involve a partner who is anti-HCV positive, and one-third involve an individual with more than two sexual partners in the previous 6 months[429]. The rate of transmission in monogamous relationships is low, about 2.5% in Canada[391].

About 10% of HCV transmission has also been reported to occur following a wide range of household and community percutaneous and mucosal contacts[426,429-432], including bites[433,434]. About 10% of infections have no identified source[429].

Despite exposure to both viruses, hepatitis C, but not HIV, was transmitted following the sharing of cleaned intravenous drug injecting equipment[435].

Hepatitis C was transmitted to two patients after a colonoscopy with equipment that had been used hours earlier on someone with hepatitis C. The scope was not properly cleaned and had accessories that were not autoclaved after each use[436].

Hepatitis C has been transmitted via saliva in an experimental setting with a chimpanzee[437].

In Canada, there were three cases of compensated occupational hepatitis (type not specified) in HCWs in 1998. Nurses and/or nursing supervisors were the health care professional group affected[401]. The area of work where the exposure occurred is unknown.

In 1998, Alter et al stated that the incidence of seroconversion following accidental sharps exposures was 1.8% (range 0% to 7%)[426]. An incidence of 10% was quoted in Japan with HCV RNA detection by PCR testing[438].

In Canada, one nurse in British Columbia contracted hepatitis C following a hollow-bore needlestick injury in the operating room and died 2 months later[439].

In the U.S., 22 hospitals participating in the National Surveillance System for Hospital Health Workers (NaSH) from 1995 to 1998 documented 374 exposures to HCV. Of the five HCWs who acquired hepatitis C infection, all five had suffered injuries with visibly bloody

devices, four involved hollow-bore needles used for venous access, and four were exposed to sources co-infected with HIV. Fifty-six percent of HCWs were not available for follow-up[440].

Since 1986 in Italy, in a network of 41 hospitals with 36,000 beds and employing 62,500 HCWs, it was found that the rate of hepatitis C infection for percutaneous exposures was 0.45% (14/3076) and for mucocutaneous exposures was 0.36% (2/557). There were no transmissions observed in the Italian study following non-intact skin exposure[115]. The rate of hepatitis C seroconversion is similar to the North American rate. The reason for the slightly higher estimation of infection after mucocutaneous exposure in Italy than in North America is the small denominator, which widens the confidence levels (personal communication: Dr. V. Puro, Studio Italiano Rischio Occupazionale HIV-Coordinating Center, IRCCS, Spallanzani, Rome, Italy, 2001). In studies conducted during the years 1994 to 1998 it has been shown that the 10 HCWs who seroconverted to hepatitis C were exposed to moderate (7) or deep (3) injuries with hollow-bore blood filled needles[441].

One HCW was infected with both HCV and HIV following a dual injury, i.e. a needlestick injury and a spill of blood from a collection vial into her gloves, on chapped hands[442]. The period before seroconversion to hepatitis C was later than would normally be expected, between 9.5 and 13.5 months. She died from hepatic coma and renal failure 28 months after the exposure[442].

One case of simultaneous HCV and HIV transmission was reported following a blood splash to the eye, despite immediate washing of the contaminated site and postexposure prophylaxis with zidovudine[443].

Stored blood samples from studies done in Pennsylvania, Georgia, Connecticut, and Florida during the years 1991 to 2000 were analyzed by CDC for hepatitis C infection. The results indicated that first responders are at a similar risk from their work exposures for hepatitis C as the general public in the areas of the U.S. that were studied[444].

An anesthesiology assistant in Germany contracted hepatitis C from a patient via an open cut on his unprotected hand and subsequently transmitted HCV from his wound secretions to five patients[445].

Two HCWs in Japan were exposed to HCV as a result of percutaneous injuries and, although both developed HCV RNA in their serum, neither developed hepatitis C; early treatment with interferon had been administered[446]. However, interferon is not recommended for postexposure prophylaxis[6].

Transmissions of bloodborne pathogens from the HCW to the patient are documented in *Proceedings of the Consensus Conference on Infected Health Care Workers: Risk for Transmission of Bloodborne Pathogens*[9,403].

• Risk Assessment of Human Immunodeficiency Virus (HIV)

1.1 Clinical Significance of HIV

HIV is a virus that causes a wide spectrum of illness and develops into acquired immune deficiency syndrome (AIDS). AIDS is a severe, life-threatening clinical condition. The syndrome represents the late clinical stage of HIV disease that results from progressive damage to the immune and organ systems, including the central nervous system[23].

HIV infected people are at greater risk of infection and serious complications from opportunistic pathogens, e.g. tuberculosis and pneumocystosis.

1.2 Evidence of Exposure/Transmission of HIV

HIV is transmitted to others via sexual contact and injection drug use, and from mother to neonate[23]. The estimated risk of transmission of HIV from blood transfusions of donated blood that is routinely screened by anti-HIV testing is 1:913,000[416,447]. In addition, HIV p24 antigen testing has been done since March 15, 1996, further lowering this risk.

HIV has been transmitted via a bite, which exposed a person to saliva with blood[448].

HIV with a zidovudine-resistant mutation has been transmitted from an HIV infected child to another child in the same home, probably from an unknown blood exposure[449].

Epidemiologic studies have shown that the risk of transmission of HIV to HCWs from HIV infected patients is approximately 0.3% following a needlestick exposure[30,394,396,450-452].

Percutaneous exposure is a more effective means of transmission than mucous membrane exposure. The rate of seroconversion following a mucous membrane exposure is 0.09%[396,405].

The Canadian National Surveillance of Occupational Exposure to the Human Immunodeficiency Virus shows that the major cause of potential exposure to HIV for HCWs in Canada is percutaneous exposure, e.g. from needlestick (62%) and surgical instruments (6%). Eleven per cent of exposures to blood are to mucous membranes, and 13% are to non-intact skin[397].

There has been one occupational HIV percutaneous transmission documented in Canada (1995). The incident occurred to a HCW who sustained a shallow puncture wound from a small-gauge needle. There was a small amount of blood at the wound site. As the incident appeared trivial the HCW did not seek antiretroviral drugs. Unfortunately, the source person was in the late stages of AIDS, and the HCW seroconverted to HIV[454].

A possible occupational transmission occurred to a 75 year old Ontario biochemist who had worked in many laboratories with blood and blood products. There were no other risk factors reported[455].

Another possible occupational transmission occurred to a Quebec laboratory technician in the early 1990s. This case is still under investigation[456].

In Canada, there has been no reported case of HIV transmission from non-intact skin or mucous membrane exposure[397].

There were seven cases of compensated lost time due to occupational HIV infection reported to the Association of Workers' Compensation Boards of Canada in 1998[401]. All the health care professionals compensated were nurses or nursing supervisors.

No evidence of aerosol transmission of HIV is available[457].

In the U.S., there were 56 HCWs with documented and 138 with possible occupational transmission of HIV as of December 2000[458]. In Europe, the United Kingdom, and the rest of the world, there have been 28, 4, and 11 documented occupational HIV seroconversions and 56, 8, and 13 possible HIV seroconversions respectively[459].

Although mucous membrane exposures have resulted in HIV seroconversion, a prospective 6 year study with U.S. HCWs, at the Clinical Center of the National Institutes of Health, found no HIV seroconversions following 2,712 cutaneous HIV exposures[460].

In Italy, the HIV transmission rate after percutaneous exposure, as collected in the national database for bloodborne pathogen exposures, was 0.14% (3 of 2,125) and after mucocutaneous exposure was 0.43% (2 of 468)[115]. The rate of seroconversions is similar to the North American rates. The reason for the slightly higher estimate of infections following mucocutaneous exposure in Italy compared with those in North America is that the small denominator widens the confidence intervals (personal communication. Dr. V. Puro, Studio Italiano Rischio Occupazionale HIV-Coordinating Center, IRCCS, Spallanzani, Rome, Italy, 2001).

Some HIV occupational infections result from very small injuries. In Germany, while a nurse was washing the patella of an AIDS patient, her gloved hand accidentally touched a tip of the internal wire inserted to fix the joint. The wire was exposed as a result of the wasting condition of the patient. The injury was superficial, of 3 mm in length, and hardly bleeding. She had immediate prophylactic zidovudine therapy, but she seroconverted months later[461].

Some exposures are more hazardous than others, e.g. after an occupational exposure HCWs are more at risk the larger the quantity of blood involved in the exposure, as the following three examples demonstrate[394]:

- 16.1 times more likely to become infected with HIV from a deep percutaneous injury (deep puncture or wound with or without bleeding) than a superficial percutaneous injury (surface scratch, no blood apparent),
- 5.2 times more likely to become infected with HIV when there is visible blood on the device causing injury, and
- 5.1 times more likely to become infected with HIV from a needle used to access a blood vessel than one used in a non-vascular site.

The risk increases if the viral titre is higher, i.e. the HCW is 6.4 times more likely to become infected from a source patient with high viral load (end stage AIDS or acute retroviral illness) than from a patient with a low viral load[394].

In a retrospective case-control study carried out from 1988 to 1994 in the U.S., United Kingdom, and France, the risk of occupational transmission of HIV was reduced by 79% when HCWs were given zidovudine (ZDV) as postexposure prophylaxis[394].

One case of simultaneous HCV and HIV transmission was reported following a blood splash to the eye, despite immediate washing of the contaminated site and postexposure prophylaxis with zidovudine[443].

When HCWs are exposed to more than one bloodborne pathogen, the seroconversion to HIV may occur later than the usual 6 months. One of four HCWs co-infected with HCV in the National Surveillance System for Hospital Health study was HIV negative at 6 months but positive for HIV 13 months after exposure[440].

One HCW was infected with both HCV and HIV following a dual injury, i.e. a needlestick injury and a spill of blood from a collection vial into her gloves, on chapped hands[442]. The time of HIV seroconversion was later than normally expected, between 8 and 9.5 months. She died 28 months after the exposure from hepatic coma and renal failure[442].

Ninety-five percent of HIV seroconversions occur within 6 months[462].

Transmissions of bloodborne pathogens from the HCW to the patient are documented in *Proceedings of the Consensus Conference on Infected Health Care Workers: Risk for Transmission of Bloodborne Pathogens*[9,403,463].

Recommendations

Compliance with the recommendations for the components of an OH program outlined in Section A–1-4 is required in addition to the following specific recommendations for bloodborne pathogens.

2. Risk Control Measures

2.1 Risk Control Measures to Prevent HCW Exposure to or Infection with Bloodborne Pathogens

2.1.1 *Engineering Controls*

OH should liaise with Administration, Infection Control, Materiels Management, and the Safety Coordinator to ensure that hazardous devices are replaced with equipment with a safer design. Although it is preferable to choose equipment that has been studied in the workplace and has been proven to be effective, with approximately 1,000 safety devices on the market in the last 20 years[84] this is not always possible. Well-designed equipment includes equipment with the use of active or passive safety devices. An active safety device requires the operator to actively engage

the safety feature in order to ensure its proper function, whereas a passive safety device is one that requires no action on the part of a HCW to ensure protection and is usually in effect throughout the use of the device[38], e.g. once the syringe has been fully engaged, the needle is drawn into the barrel. Consideration should be given to the following:

- passive retractable needles to reduce injuries at the point of use[464] and eliminate the need to recap[37],
- active and passive retractable needles[465] and blunt suture needles[55] to eliminate injuries at point of use,
- retractable intravenous catheter needles[466],
- alternatives to butterfly needles,
- mechanical devices in the laboratory[11],
- needleless intravenous systems to reduce injuries at point of use and eliminate the need to recap[88-90],
- sharps disposal containers placed close to the bedside to reduce the need to recap[467,468]. **AIII**

2.1.2 *Administrative Controls*

Administration should ensure that OH develops policies and procedures to obtain consent for all testing, including tests for HBV, HCV, and HIV[12,19,96,97,99,114]. **AIII**

2.1.3 *OH Work Practices to Prevent HCW Exposure to or Infection with Bloodborne Pathogens*

2.1.3.1 Hepatitis B

OH should document HCW immune status for hepatitis B[79] at the preplacement examination[29,36]. **AIII**

OH should consider HCWs to be immune to hepatitis B when there is evidence of 3 doses of hepatitis B vaccine given at 0, 1, and 6 months and one documented adequate hepatitis B surface antibody (anti-HBs) titre according to standard laboratory tests done at least 4 to 8 weeks after immunization; or when the HCW is anti-HBs positive or is hepatitis B core antibody (anti-HBc) positive or is HBsAg positive from hepatitis B infection[12]. Provincial/territorial guidelines may vary. **AIII**

OH should immunize all HBV susceptible HCWs who may be exposed to blood, blood products, or body fluids or others who may be at increased risk of sharps injury or bites, e.g. staff of institutions for the developmentally challenged; 3 doses of hepatitis B vaccine should be given at 0, 1, and 6 months unless contraindicated[8]. **AIII**

OH should conduct serologic testing for hepatitis B surface antibody 4 to 8 weeks[12,410,469] or at least within 6 months after the third dose[8]. **BII**

OH should immunize HCWs who did not produce adequate anti-HBs after an initial 3-dose vaccine series (non-responders) with a second 3-dose series of hepatitis B vaccine and repeat serologic testing[8]. **BIII**

OH should consider HCWs who do not produce anti-HBs after two complete series of HB vaccine (non-responders) as susceptible to hepatitis B indefinitely[8,12]. Further hepatitis B immunization is unlikely to offer benefit. **BIII**

OH should advise HCWs that booster doses are not recommended for hepatitis B[8,409,410]. **BII**

OH should advise HCWs who have been immunized against hepatitis B but who never received postimmunization serologic testing to seek testing for anti-HBs either as part of routine follow-up when an exposure occurs or according to OH policies for documenting protective levels. If the antibody test is negative, OH should give a booster and retest. **AIII**

OH should advise HCWs who perform exposure-prone procedures that they have an ethical obligation to know their serologic status for HBV and to follow the recommendations in *Proceedings of the Consensus Conference on Infected Health Care Workers: Risk of Transmission of Bloodborne Pathogens*[9]. **AIII**

OH should develop strategies to achieve hepatitis B immunization of 100% of HCWs who may be exposed to bloodborne pathogens. These strategies could include the following:

- increase compliance of immunization coverage by enhancing the acceptance of vaccines[79], making vaccine convenient and accessible to all HCWs, e.g. at the work site[411], at meetings, and on all shifts[105], and sending reminder letters for subsequent doses[411]. **BIII**
- collaborate with associated HCW educational facilities to require hepatitis B immunization and postimmunization testing to confirm protection and proof of immunity prior to clinical practice in the educational program. **BIII**

2.1.3.2 Hepatitis C

OH should consider all HCWs to be susceptible to hepatitis C even with laboratory documentation of previous infection, since infection with one genotype of virus is not protective against infection with another genotype. **AIII**

OH should advise HCWs who perform exposure-prone procedures that they have an ethical obligation to know their serologic status for HCV and to follow the recommendations in *Proceedings of the Consensus Conference on Infected Health Care Workers: Risk of Transmission of Bloodborne Pathogens*[9]. **AIII**

2.1.3.3 HIV

OH should consider all HCWs to be susceptible to HIV even with laboratory documentation of previous infection, since infection with one genotype of virus is not protective against infection with another genotype. **AIII**

OH should advise HCWs who perform exposure-prone procedures that they have an ethical obligation to know their serologic status for HIV and to follow the recommendations in *Proceedings of the Consensus Conference on Infected Health Care Workers: Risk of Transmission of Bloodborne Pathogens*[9]. **AIII**

2.1.3.4 Undefined Bloodborne Pathogens

OH should advise HCWs with significant dermatitis about increased risks of exposure to and transmission with bloodborne pathogens[95,470], how to minimize risk, and the need to refrain from direct patient care if reduction in risk is not possible[45,81]. **BIII**

OH should analyze data from needlestick injuries to determine surveillance rates. The data include, but are not limited to[48,77]

- type and size of device[52],
- type of procedure and degree of risk involved,
- task of HCW,
- location of the incident,
- circumstances of the incident, equipment problems[52],
- time of exposure,
- workload,
- change in rates of injuries before and after introduction of a safety device and whether the safety feature was activated[38,48]. **AIII**

OH should provide leadership on a multidisciplinary committee for sharps prevention, whose role it is to

- define the priorities for safety products according to the epidemiologic analysis of the institution's injury data[31,52,471],
- determine the goal for the decrease in needlestick injuries[48],

- determine the selection of design (a safety feature that is simple, reliable, and self-evident to operate) and performance criteria (design and performance for patient care and worker safety) for products associated with high risk of injury or exposure, e.g. those involving large volumes of blood, vein or artery placement, or potential for deep injury[38,471,472]. Cost and any potential increased risk to the patient of infection by the use of safer products should be considered[52],
- evaluate clinical studies, review other written resources on safer devices[471],
- identify, evaluate, and select sharps prevention technology for staff to pilot test in the clinical area[38,48],
- select and recommend effective equipment chosen from the pilot study[38,48],
- arrange for hands-on-training for equipment use[38,48],
- assess outcomes of equipment and/or procedure changes and identify unanticipated problems as part of the evaluation process[37,38,48],
- establish a process for reporting product problems to the manufacturer[48],
- participate in research initiatives, if possible, to support the need for safer equipment and/or procedures[471] and for the ultimate benefit to patient care,
- design interventions, including work practices and modification of procedures, tailored to reduce specific occupational hazards[66] without compromising patient safety,
- conduct research on staffing patterns and needlestick injury rates[47,48,66], if possible,
- contribute to a list of effective safer devices available[38,48] (U.S. resources are available on the Web[473]),
- study the cost-effectiveness of safer equipment[38],
- determine the necessity for extra training to assist HCWs adapt to the new technology once it has been chosen, e.g. practices of phlebotomy and the insertion of intravenous catheter may require technique changes[48,50],
- review target goals for reduction in needlestick injuries and provide remedial action if necessary[48],
- encourage manufacturers to conduct postmarketing studies[48]. **BIII**

OH should consider participation in the Canadian Needle Stick Surveillance Network (CNSSN) to pool data regarding needlestick injuries and seroconversions (see Appendix III). **BIII**

2.1.4 *Personal Protective Equipment*

See Section A-2.1.4

Additional information is available in *Preventing the Transmission of Bloodborne Pathogens in Health Care and Public Service Settings*[11] and in Appendix II: Literature Review of Bloodborne Pathogen Exposures to Health Care Workers and their Control Measures, page 201 of this guideline.

2.2 Risk Control Measures to Manage HCWs Exposed to or Infected with Bloodborne Pathogens

OH should instruct HCWs to allow immediate bleeding of a percutaneous injury and wash the injured area well with soap and water, applying an antiseptic, if available, as a first aid measure[11,12]. **AIII**

OH should instruct HCWs to flush eyes, nose, or mouth with copious amounts of water as a first aid measure if blood or body fluid contamination occurs[11,12]. **AIII**

OH should instruct HCWs to wash skin with soap and water if blood or body fluid contamination occurs[11,12]. **AIII**

2.2.1 *Assessment of HCW Exposure to Bloodborne Pathogens*

2.2.1.1 Method of Transmission of Bloodborne Pathogens

Bloodborne pathogens are transmitted primarily by percutaneous injury with equipment contaminated with blood or body fluids but also by mucous membrane or non-intact skin contact with blood or body fluids. See *An Integrated Protocol to Manage Health Care Workers Exposed to Bloodborne Pathogens*[11,12].

The types of body fluids capable of transmitting HBV, HCV, or HIV from an infected individual include[12]

- blood, serum, plasma, and all biologic fluids visibly contaminated with blood,
- laboratory specimens, samples, or cultures that contain concentrated HCV, HBV, or HIV,
- organ and tissue transplants,
- pleural, amniotic, pericardial, peritoneal, synovial, and cerebrospinal fluids,
- uterine/vaginal secretions or semen (unlikely to transmit HCV), and
- saliva for HBV only, unless contaminated with blood.

Feces, nasal secretions, sputum, tears, urine, and vomitus are not implicated in the transmission of HCV, HBV, and HIV unless visibly contaminated

with blood. The risk of transmission from screened donated blood and manufactured blood products is negligible in Canada.

2.2.1.2 Definition of Occupational Exposure to Bloodborne Pathogens

OH should define HCW exposure as a percutaneous injury from equipment contaminated with blood or body fluids (see 2.2.1.1), or mucous membrane or non-intact skin contact with blood or body fluids (see 2.2.1.1). Blood on intact skin is not an exposure[19]. See *An Integrated Protocol to Manage Health Care Workers Exposed to Bloodborne Pathogens*[12]. **AIII**

2.2.2 *Assessment of Source of HCW Exposure*

In collaboration with IC, OH should confirm the diagnosis of the source and assess the potential for communicability at the time of HCW exposure[12]. **AIII**

OH should determine the circumstances of the injury, which may be associated with a higher risk of disease transmission, for example, if it involved a hollow-bore device or a device used for vascular access, if a percutaneous injury was relatively deep, if there was visible blood on the device, or if the source patient had a high viral load or was in the terminal phase of illness[394]. **AII**

2.2.2.1 Communicability of Source

The incubation periods are as follows:

- hepatitis B is 45 to 180 days, and the period of communicability is as long as HBsAg is present in the blood,
- hepatitis C is 14 to 180 days, and the period of communicability is from the time HCV is present in the blood and throughout life,
- HIV is usually 30 to 90 days but may be longer. The period of communicability is from the time the virus is present in the blood and throughout life. See *Preventing the Transmission of Bloodborne Pathogens in Health Care and Public Service Settings*[11,23].

2.2.3 *Criteria to Confirm the Diagnosis of Bloodborne Pathogens*

2.2.3.1 Hepatitis B

Clinical illness
– **acute**: fever, headache, anorexia, malaise, nausea, vomiting, abdominal discomfort, jaundice, polyarthralgia, arthritis, or macular rash

– **chronic**: fatigue, right upper quadrant pain, jaundice, weight loss, ascites, increasing abdominal pain, cirrhosis, or hepatocellular carcinoma

Plus laboratory evidence – hepatitis B surface antigen positive for HBV; HBV-DNA positive (available at some reference laboratories)

Or – laboratory evidence without clinical illness

2.2.3.2 Hepatitis C

Clinical illness
– **acute**: fever, headache, anorexia, malaise, nausea, vomiting, abdominal discomfort, jaundice, polyarthralgia, arthritis, or macular rash

– **chronic**: fatigue, right upper quadrant pain, jaundice, weight loss, ascites, increasing abdominal pain, cirrhosis, or hepatocellular carcinoma

Plus laboratory evidence: antibody to HCV positive; HCV-RNA positive (available at most reference laboratories)

Or – laboratory evidence without clinical illness.

2.2.3.3 Human Immunodeficiency Virus

Clinical illness
– **acute**: self-limited mononucleosis-like syndrome, aseptic meningitis, or fever with rash illness

– **chronic**: generalized lymphadenopathy, hepatomegaly, splenomegaly, oral candidiasis, recurrent diarrhea, wasting syndrome, parotitis, cardiomyopathy, hepatitis, failure to thrive, nephropathy, central nervous system disease, pneumonia, recurrent invasive bacterial infections, opportunistic infections, or specific malignant neoplasms

Plus laboratory evidence: antibody to HIV positive; HIV-RNA positive; HIV provirus positive; HIV p24 antigen positive (available at some reference laboratories)

Or – laboratory evidence without clinical illness

2.2.4 *OH Work Practices to Manage HCWs Exposed to or Infected with Bloodborne Pathogens*

2.2.4.1 HCWs Exposed to Undefined Bloodborne Pathogens (HBV, HCV, or HIV)

OH should determine the immune status of the exposed HCW. If the source tests positive for HBV, HCV, or HIV and the HCW's immune status for HBV, HCV, or HIV is unknown or uncertain, OH should test the HCW for HBsAg, anti-HBs, anti-HBc, anti-HCV, serum alanine aminotransferase (ALT) and anti-HIV according to *An Integrated Protocol to Manage Health Care Workers Exposed to Bloodborne Pathogens*[12]. Provincial/territorial recommendations may vary. **AIII**

OH should consider HCWs to be immune to **HBV** when there is evidence of 3 doses of hepatitis B vaccine given at 0, 1, and 6 months and one documented adequate anti-HBs titre, according to standard laboratory

tests, done at least 4 to 8 weeks after immunization; or if the HCW is anti-HBs positive, anti-HBc positive, or HBsAg positive from hepatitis B infection[12]. Provincial/territorial guidelines may vary. **AIII**

OH should consider all HCWs to be susceptible to **HCV** even with laboratory documentation of previous infection, since infection with one genotype of virus is not protective against infection with another genotype. *However*, an HCV-infected HCW does not require postexposure testing for HCV. **AIII**

OH should consider all HCWs to be susceptible to **HIV** even with laboratory documentation of previous infection, since infection with one genotype of virus is not protective against infection with another genotype. *However*, an HIV-infected HCW does not require postexposure testing or prophylaxis for HIV. The HIV specialist may adjust HCWs' drug regimen if they are resistant to the HIV strain of the source. **AIII**

OH should refer the exposed HCW for clinical management, which may include

- immunization with hepatitis B vaccine unless contraindicated[8,12],
- administration of hepatitis B immune globulin as soon as possible, preferably within 48 hours of exposure[8,12],
- administration of prophylactic anti-retroviral drugs against HIV, as soon as possible and preferably within 1 to 2 hours[12],
- reassessment and management of HCWs already infected with HCV or HIV,
- see *An Integrated Protocol to Manage Health Care Workers Exposed to Bloodborne Pathogens*[12]. **AIII**

OH should refer exposed pregnant HCWs to their physicians for clinical management immediately, particularly regarding the decision to start postexposure prophylaxis for HIV. This decision should be made in consultation with an infectious diseases specialist. **AIII**

OH should arrange for ongoing follow-up management and testing over the 6 months unless it is determined that in a specific case the follow-up should be longer[12]. **BIII**

There are no modifications to work practices and no work restrictions for HCWs exposed to bloodborne pathogens.

OH, as a part of the safety team, should ensure that the investigation of the work site has been reviewed and discussed with regard to specific issues of procedure, equipment, or behaviour and that preventive action has been recommended[51]. **AIII**

OH should ensure that emergency responders are included in the identification of exposed HCWs and that public health authorities are notified in a timely manner regarding testing and postexposure management. See *A National Consensus on Guidelines for Establishment of a Post-Exposure Notification Protocol for Emergency Responders*[19,96-99,114]. **BIII**

2.2.4.2 HCWs Symptomatic or Infected with a Bloodborne Pathogen

OH should advise HCWs who perform exposure-prone procedures that they have an ethical obligation to know their serologic status for HBV, HCV, or HIV and to follow the recommendations in *Proceedings of the Consensus Conference on Infected Health Care Workers: Risk of Transmission of Bloodborne Pathogens*[9]. **AIII**

OH should refer HCWs who are symptomatic or infected with HBV, HCV, or HIV for confirmation of diagnosis and for clinical management, which may include laboratory investigation and current treatment[6,12]. **AIII**

OH should refer HCWs with significant dermatitis for clinical management[81]. **BIII**

OH should refer pregnant HCWs who are symptomatic or infected with HBV, HCV, or HIV to their physicians for clinical management in consultation with an infectious diseases specialist. **BIII**

There are no modifications to work practices or work restrictions for HCWs infected with HBV, HCV, or HIV, providing they do not perform exposure-prone procedures. See the *Proceedings of the Consensus Conference on Infected Health Care Workers: Risk of Transmission of Bloodborne Pathogens*[9].

There may be modifications to work practices or work restrictions for HCWs who perform exposure-prone procedures and are infected with HBV, HCV, or HIV. See the *Proceedings of the Consensus Conference on Infected Health Care Workers: Risk of Transmission of Bloodborne Pathogens*[9].

There may be modifications to work practices or work restrictions for HCWs with significant dermatitis[45,81].

OH should arrange for ongoing testing for HBV of HCWs who are non-responders or for whom immunization is contraindicated. **AIII**

OH should assess for fitness to work those HCWs who are immunocompromised as a result of HIV: assess the type of patient population care activities the HCW will be exposed to, since he or she should avoid exposure to infectious tuberculosis[17] and certain other infections, e.g. varicella-zoster virus, influenza. **BIII**

OH may participate in an expert panel to review the work practices of a HCW who performs exposure-prone procedures and is infected with HBV, HCV, or HIV. See the *Proceedings of the Consensus Conference on Infected Health Care Workers: Risk of Transmission of Bloodborne Pathogens*[9]. **AIII**

OH may participate in monitoring the work practices of a HCW who performs exposure-prone procedures and is infected with HBV, HCV, or HIV. See the *Proceedings of the Consensus Conference on Infected Health Care Workers: Risk of Transmission of Bloodborne Pathogens*[9]. **AIII**

2.2.4.3 OH Management of a Bloodborne Pathogen Outbreak

OH should consider the possibility of an outbreak if more than one HCW on the same unit meet the criteria for diagnosis of HBV, HCV, or HIV. **AIII**

OH should liaise with IC and public health authorities if an outbreak is suspected. **AIII**

2.2.4.4 OH Reporting to Public Health Authorities of HCWs with a Bloodborne Pathogen Infection

OH should report a case or a suspected or confirmed outbreak of HBV, HCV, or HIV to public health authorities as required by legislation.

3. Education of HCWs about Prevention and Management of Exposure to or Infection with Bloodborne Pathogens

OH should design education specific to bloodborne pathogens according to the recommendations outlined in Section A-3 and including the following:

- hazards and magnitude of the risks associated with bloodborne pathogens[474],
- safety and effectiveness of immunization with hepatitis B vaccine[8],
- risks associated with dermatitis[45,81,95,470],
- differing risks for bloodborne pathogen exposures present in the various tasks conducted in the workplace[472],
- incorporation of practices previously called universal precautions (UP)[81,475,476] and bloodborne pathogen precautions (BBPs)[11] into Health Canada's *Routine Practices and Additional Precautions for Preventing the Transmission of Infection in Health Care*[4] and *Hand Washing, Cleaning, Disinfection and Sterilization in Health Care*[10],
- need for prompt first aid procedures and prompt reporting to designated personnel[12,19],
- risk assessment of the exposure and the importance of starting postexposure prophylaxis for HIV as quickly as possible, preferably within 1 to 2 hours, and for HBV within 48 hours[12],
- results of needlestick injury surveillance and prevention strategy outcomes[48,49],
- benefits of needlestick prevention devices[48,101,477],

- benefits of communication, a safety zone, and "hands-free" technique in the operating room[51,439],
- additional information is available in *Preventing the Transmission of Bloodborne Pathogens in Health Care and Public Service Settings*[11]. **AIII**

OH should liaise with Educational Services, Infection Control, and the Safety Coordinator to perform or facilitate training on the following:

- use of safer techniques involving organization and coordination of the environment, e.g. location of sharps disposal containers[11,87],
- use of specific needlestick-prevention devices, including opportunities to practise operating the device[474],
- use of the most appropriate personal protective equipment by HCWs[101],
- modifications of procedures intrinsically associated with occupational risks[11,45,51],
- surgical procedure techniques taught to medical students on plastic models and cadavers[478],
- adaptive process[91,104] involved in changing from older equipment and work practices to safer but initially less familiar equipment and work practices. **BIII**

OH should liaise with Education Services and Infection Control to distribute information in a variety of ways on the prevention of blood and body fluid exposures:

- distribution of educational memoranda, e.g. paycheck enclosures and posting of educational materials[411],
- publishing notices in the hospital newsletter[465],
- special exhibits during Occupational Health and Safety week,
- bloodborne pathogen pocket cards for instructions in the event of a bloodborne pathogen exposure[479]. **BIII**

OH should consider the various stages involved in behavioural change when designing educational programs to assist employees[91-93]. **BIII**

4. Evaluation of the OH Program to Prevent and Manage Exposures to or Infections with Bloodborne Pathogens

OH should implement ongoing evaluation of strategies to prevent exposure to bloodborne pathogens by means of, but not limited to, the following indicators:

- the percentage of HCWs who are immunized against hepatitis B,
- the outcomes for needlestick and other sharps reduction policy:
  - rates of all percutaneous injuries including time, type of work, task of HCW, device, procedure,
  - use of sharps prevention technology,
  - product evaluation before and after implementation,

- impact of hands-on training programs for use of sharps prevention technology,
- impact of risk reduction strategies,
- impact of work modifications for risk reduction that do not compromise patient safety, and
- cost-effectiveness of safer equipment.

- the rates of exposure to bloodborne pathogens involving mucous membranes and non-intact skin,
- the compliance with postexposure protocols,
- the rates of seroconversion of HCWs to hepatitis B, hepatitis C, or HIV from positive source patients and
- the results of worksite evaluations. **C**

OH should evaluate participation in the Canadian Needle Stick Surveillance Network (see Appendix III). **BIII**

– Section C –
Health Care Worker Immunization and Recommendations

The following information is adapted from Health Canada's *Canadian Immunization Guide*[8] or newly published recommendations from the National Advisory Committee on Immunization (NACI). Recommendations that differ from those of NACI are based on current literature and the consensus of the working committee for this guideline, and will be clearly indicated in Table III: Recommendations for Health Care Worker Immunization. The area of immunization is frequently updated, and the reader should refer to the most current published guidelines. As well, public health legislation supersedes these recommendations, and the reader should be familiar with provincial/territorial requirements.

Hospital employees, students in health care disciplines, laboratory workers, and other health care personnel are at risk of exposure to communicable diseases because of their contact with patients or material from patients with infections, both diagnosed and undiagnosed. Maintenance of immunity against vaccine-preventable diseases is an integral part of an occupational health program. Optimal usage of immunizing agents will not only safeguard HCWs but may, in some instances, also protect patients from becoming infected by employees.

The immunization status of each worker should be assessed at the time of initial employment. A full vaccination history should be elicited and efforts made to obtain documentation of the doses received and dates of administration. Persons who cannot provide acceptable information or evidence of adequate immunity should be offered immunization at the earliest opportunity. Records of all immunizations

and serologic tests should be kept by both employer and employee and a recall system for boosters instituted.

Immunization policies at individual health care settings will vary, and decisions about which vaccines to be included should take account of the size of the workplace, the exposure risks for the HCW, and the nature of employment. It is important to include increased acceptance of vaccinations as an educational objective in employee in-service as well as increased awareness of illness or symptoms that require evaluation. Similarly, it is important for Administration and OH to consider the need to require HCW immunity to some diseases as a condition of employment and to determine which vaccine programs take priority.

Readers are encouraged to refer to Section B for details regarding management of HCWs exposed to or infected with a specific disease.

Recommendations (to be used with Table III):

It is the responsibility of Administration to provide sufficient resources to Occupational Health programs to achieve the following recommendations.

The following should be considered as priorities:

1. Administration and OH should consider immunization against hepatitis B, influenza, measles, mumps, rubella, and varicella as priorities because of the greater risk of exposure to and transmission of disease by HCWs[78]. **AIII**

2. Administration and OH should consider measles, rubella, mumps, hepatitis B, and varicella immunity as a condition of employment for new HCWs. **AIII**

3. Administration and OH should consider annual influenza immunization as a condition of employment for HCWs working in long-term care settings[173]. **AI**

4. OH should review the immunization history at the preplacement examination. **AIII**

5. OH should refer susceptible immunocompromised HCWs to their physicians for consideration of immunization. **AIII**

6. OH should provide immunization as recommended in Table III (next page), unless the HCW is immune or contraindications apply. A recall system for booster doses of vaccine should be in place. **AIII**

Table III: Recommendations for Health Care Worker Immunization

Vaccine	Consider HCWs Immune/Susceptible	Immunization Recommendations
Diphtheria	▪ all susceptible: immunization may not be fully protective against infection since immunity is antitoxic, i.e. protects against serious disease[142]	NACI recommends: ▪ all HCWs have a complete primary series of 3 doses of a combined tetanus and diphtheria (Td) preparation unless contraindicated[8,142]. ▪ booster doses of Td every 10 years for HCWs[8] or, at a minimum, at least once as an adult, e.g. at age 50 if it has been 10 years or more since the last booster unless contraindicated[8,142,153].
Hepatitis A virus (HAV)	▪ immune with evidence of hepatitis A immunization or documentation of HAV IgG[8]	NACI does not recommend routine immunization of HCWs, including foodhandlers; consider in institutions for the developmentally challenged where there is an ongoing problem with HAV transmission[8,365].
Hepatitis B virus (HBV)	▪ immune with evidence of 3 doses of hepatitis B vaccine given at 0, 1, and 6 months and one documented adequate hepatitis B surface antibody (anti-HBs) titre according to standard laboratory tests done at least 4 to 8 weeks after immunization; or anti-HBs positive, hepatitis B core antibody (anti-HBc) positive, or hepatitis B surface antigen (HBsAg) positive from hepatitis B infection[12]. Provincial/ territorial guidelines may vary.	NACI recommends: ▪ for all susceptible HCWs who may be exposed to blood, blood products or body fluids or others who may be at increased risk of sharps injury or bites, e.g. staff of institutions for the developmentally challenged, 3 doses of hepatitis B vaccine, given at 0, 1, and 6 months unless contraindicated[8]. ▪ post-immunization serologic testing for anti-HBs should be conducted on all immunized HCWs after 4 to 8 weeks[12,410,469], or at least within 6 months after the third dose, to determine whether they are immune[8]. Non-responders should be immunized with a second 3-dose series of hepatitis B vaccine unless contraindicated, and serologic testing should be repeated[8]. ▪ non-responders who have received two complete 3-dose series of hepatitis B vaccine should be considered susceptible to hepatitis B virus indefinitely[8,12]. Further hepatitis B immunization is unlikely to offer benefit. ▪ routine booster doses of hepatitis B vaccine are not recommended for HCWs[8,409,410].

Refer to Section B for details regarding management of HCWs exposed to or infected with a specific disease.

Table III: Recommendations for Health Care Worker Immunization

Vaccine	Consider HCWs Immune/Susceptible	Immunization Recommendations
Influenza	All susceptible because strains change annually, immunization has an efficacy of about 70%-80% and a short protective period of about 6 months, and the vaccine components change annually[8,23,24]	NACI recommends: ▪ annual influenza immunization *only* for HCWs who have significant contact with individuals in high-risk groups. Such personnel include physicians, nurses, and others in both hospital and outpatient settings; HCWs of chronic-care facilities who have contact with residents; providers of home care, visiting nurses or volunteers; and household members of persons at high risk[8,170]. *However*, all HCWs are at greater risk of exposure to and transmission of influenza. *Therefore irrespective of whether HCWs have direct contact with high-risk individuals,* ▪ annual influenza immunization should be offered to *all* HCWs unless contraindicated[175,180-182].
Measles (Rubeola)	▪ immune if born before 1970 or if born in or after 1970 with evidence of · 2 doses of live measles-containing vaccine or · physician-diagnosed measles or · documentation of measles IgG[8,187,193,194,198]	NACI recommends: ▪ immunization for all susceptible HCWs with 2 doses of live measles-containing vaccine given as measles, mumps, rubella (MMR) at least 1 month apart unless contraindicated[8,78,187,192-194,196,202]. Ensure that a second dose of measles vaccine (MMR) is given to HCWs born in 1970 or after who have previously received only one dose, to provide optimal protection unless contraindicated[202].
Meningococcus (*Neisseria meningitidis*)		NACI does not recommend routine immunization of HCWs[8].
Mumps	▪ immune if born before 1970 or if born in or after 1970 with evidence of · 1 dose of live mumps-containing vaccine or · physician-diagnosed mumps or · documentation of mumps IgG[8]	NACI recommends: ▪ immunization for all susceptible HCWs with a single dose of live mumps-containing vaccine given as measles, mumps, rubella (MMR) unless contraindicated[8,187,199,217,219].

Refer to Section B for details regarding management of HCWs exposed to or infected with a specific disease.

Table III: Recommendations for Health Care Worker Immunization

Vaccine	Consider HCWs Immune/Susceptible	Immunization Recommendations
Pertussis (Whooping Cough)	All susceptible since immunity wanes[232,233]	NACI does not recommend immunization with whole cell vaccine for persons older than 7 years of age because adverse reactions may be more common and disease is typically less severe than in young children[8]. Study of the new acellular vaccine regarding safety, immunogenicity and efficacy in adults is in progress. Although acellular vaccine, which includes tetanus and diphtheria with the pertussis, is now licensed for adults and NACI recommends that one dose (dTap) can be used instead of tetanus-diphtheria (Td) vaccine in adults who have to be protected against diphtheria and tetanus, safety data are lacking for more than one dose. Until the use in adults is clarified and guidelines are published regarding repeated doses, there is no NACI recommendation for universal use or as part of repeated tetanus-diphtheria boosters at the time of this publication[8,235].
Polio	▪ immune with evidence of completed primary series of poliovirus vaccine (oral or inactivated)[8]	NACI recommends: ▪ all persons have a complete primary series of 3 doses of either oral polio vaccine or inactivated polio vaccine unless contraindicated. *However*, HCWs should receive only inactivated polio vaccine as the use of live-virus vaccine may cause fecal shedding and inadvertently expose immunocompromised patients to live virus[8]. ▪ booster doses of polio vaccine are not recommended[8].
Rabies	Susceptible unless there is evidence of a completed series of rabies vaccinations and appropriate booster doses to maintain an adequate antibody titre[8]	NACI does not recommend routine immunization of HCWs; vaccine should be considered for laboratory workers in specialized reference or research facilities who handle live rabies virus[8].

Refer to Section B for details regarding management of HCWs exposed to or infected with a specific disease.

Table III: Recommendations for Health Care Worker Immunization

Vaccine	Consider HCWs Immune/Susceptible	Immunization Recommendations
Rubella (German Measles)	▪ immune with evidence of · one dose of live rubella-containing vaccine or · documentation of rubella IgG[8]	NACI recommends: ▪ immunization *only* for female HCWs of childbearing age without documented immunity and susceptible HCWs of either sex who may, through frequent direct face-to-face contact, expose pregnant women to rubella[8]. *However*, all HCWs may expose and transmit rubella to pregnant females. *Therefore, irrespective of NACI recommendations:* ▪ immunize all susceptible HCWs with a single dose of live rubella-containing vaccine given as measles, mumps, and rubella (MMR) vaccine unless contraindicated[242-245,247,249]. Vaccine should not be administered to susceptible female HCWs during pregnancy because of the theoretic risk of the rubella vaccine causing adverse consequences to the fetus. Vaccine should be offered post-partum if not provided by the physicians after delivery[8]. Female HCWs of child-bearing age should avoid pregnancy for 1 month after MMR immunization[8].
Tetanus	▪ immune with evidence of completed primary series of tetanus vaccinations and booster doses at 10 year intervals[8]	NACI recommends: ▪ all HCWs have a complete primary series of 3 doses of a combined tetanus and diphtheria (Td) preparation unless contraindicated[8,142]. ▪ booster doses of Td every 10 years for HCWs[8] or, at a minimum, at least once as an adult, e.g. at age 50 if it has been 10 years or more since the last booster unless contraindicated[8,142]. ▪ booster dose of Td should be considered in the event of a tetanus-prone wound unless contraindicated[8,142].
Typhoid		NACI does not recommend routine immunization of HCWs; vaccine should be considered for laboratory workers in specialized reference or research facilities who frequently handle cultures of *Salmonella typhi*[8].

Refer to Section B for details regarding management of HCWs exposed to or infected with a specific disease.

Table III: Recommendations for Health Care Worker Immunization

Vaccine	Consider HCWs Immune/Susceptible	Immunization Recommendations
Varicella (Chickenpox)	▪ immune with evidence of · self reported history of varicella or herpes zoster or · physician-diagnosed varicella or herpes zoster or · documentation of VZV IgG or · 2 doses of live varicella vaccine, given at least 1 month apart (for adults)[7,331,332,337]	NACI recommends: ▪ immunization of all susceptible newly hired HCWs with 2 doses of live varicella vaccine, given at least 1 month apart (for adults) unless contraindicated, within 2 months of hiring; of current HCWs commencing with those who work in high-risk settings; and of all HCWs by the year 2003[7,332]. Vaccine should not be administered to susceptible female HCWs during pregnancy[7,332]. Female HCWs of child-bearing age should avoid pregnancy for 1 month after immunization[332]. Booster doses of varicella vaccine are not recommended[7,332,337].

Refer to Section B for details regarding management of HCWs exposed to or infected with a specific disease.

– Section D –
Summary Table

Table IV: Summary Table

Disease	Exposure Definition	Prophylaxis for E	Treatment for C/S/I	Work Restrictions E or C/S/I
Adenovirus – epidemic kerato-conjunctivitis (EKC)	Direct or indirect contact of ocular mucous membranes with infectious eye secretions.	No	No	I – Yes See p. 30
Bloodborne pathogens	A percutaneous injury from equipment contaminated with blood or body fluids (see next page), or mucous membrane or non-intact skin contact with blood or body fluids*. Blood on intact skin is not an exposure[19]. See *An Integrated Protocol to Manage Health Care Workers Exposed to Bloodborne Pathogens*[12].			
· HBV		Yes	S/I – Yes	S/I – there may be modifications to work practices or work restrictions for HCWs with significant dermatitis and for HCWs who perform exposure-prone procedures and are infected with HBV
· HCV		No	S/I – Yes	S/I – there may be modifications to work practices or work restrictions for HCWs with significant dermatitis and for HCWs who perform exposure-prone procedures and are infected with HCV

Legend: E – Exposed, C/S/I – Colonized or Symptomatic or Infected

Table IV: Summary Table

Disease	Exposure Definition	Prophylaxis for E	Treatment for C/S/I	Work Restrictions E or C/S/I
· HIV		Yes	S/I – Yes	S/I – there may be modifications to work practices or work restrictions for HCWs with significant dermatitis and for HCWs who perform exposure-prone procedures and are infected with HIV
	* The types of body fluids capable of transmitting HBV, HCV, and HIV from an infected individual include[12] · blood, serum, plasma, and all biologic fluids visibly contaminated with blood, · laboratory specimens, samples or cultures that contain concentrated HCV, HBV, HIV, · organ and tissue transplants, · pleural, amniotic, pericardial, peritoneal, synovial, and cerebrospinal fluids, · uterine/vaginal secretions or semen (unlikely to be able to transmit HCV) and · saliva for HBV only, unless contaminated with blood. Feces, nasal secretions, sputum, tears, urine, and vomitus are not implicated in the transmission of HCV, HBV and HIV unless visibly contaminated with blood. The risk of transmission from screened donated blood and manufactured blood products is negligible in Canada.	See p. 175	See p. 176	See p. 176

Legend: E – Exposed, C/S/I – Colonized or Symptomatic or Infected

Table IV: Summary Table

Disease	Exposure Definition	Prophylaxis for E	Treatment for C/S/I	Work Restrictions E or C/S/I
Creutzfeldt-Jakob disease (CJD)	Refer to *Creutzfeldt-Jakob Disease (CJD) in Canada* (in preparation)[2] and related provincial/territorial recommendations.	No	No	No
Cytomegalovirus (CMV)	Direct contact of mucous membranes with infectious saliva, genital secretions or urine.	No	S/I - Yes See p. 36	No
Diphtheria	Droplet contact of HCWs' oral or nasal mucous membranes with oropharyngeal secretions infected with a toxigenic strain of *C. diphtheriae;* direct contact of non-intact skin or mucous membranes with drainage from skin lesions infected with a toxigenic strain of *C. diphtheriae.*	Yes See p. 41	C/S/I – Yes See p. 42	E – Yes C/S/I – Yes See p. 42
Epstein-Barr virus (EBV)	Direct or indirect contact of oral mucous membranes with infectious saliva.	No	No	No
Gastroenteric infections	Direct or indirect oral contact with infectious feces; exposure may also occur with ingestion of contaminated food or water.	No	S/I – No for most-dependent on etiology See p. 150	S/I – Yes See p. 150
Hepatitis A virus (HAV)	A susceptible person having direct or indirect oral contact with infectious feces; exposure may also occur with ingestion of contaminated food or water.	Yes See p. 145	No	S/I – Yes See p. 145
Hepatitis E virus (HEV)	A susceptible person having direct or indirect oral contact with infectious feces; exposure may also occur with ingestion of contaminated food or water.	No	No	S/I – Yes See p. 145

Legend: E – Exposed, C/S/I – Colonized or Symptomatic or Infected

Table IV: Summary Table

Disease	Exposure Definition	Prophylaxis for E	Treatment for C/S/I	Work Restrictions E or C/S/I
Herpes simplex virus (HSV)	Direct or indirect contact of non-intact skin or mucous membranes with infectious oral or genital secretions, lesion drainage, or any secretions or excretions from an infected neonate.	No	S/I – Yes See p. 50	S/I – Yes See p. 50
Influenza	Droplet or indirect contact of oral, nasal, or conjunctival mucous membranes with infectious respiratory secretions.	Yes for unimmunized, immunocompromised See p. 56	S/I – Yes See p. 56	S/I – Yes See p. 56
Malaria	N/A	No	S/I – Yes Consult infectious diseases specialist and public health authorities	No
Measles (Rubeola)	A susceptible HCW spending any time in an enclosed airspace, i.e. the same room, being in face-to-face contact with an infectious patient in an open area, or being in a room (within 2 hours of an infectious patient being there) supplied by a ventilation system that recirculates contaminated air, during the 5 days before to 4 days after the onset of the rash.	Yes See p. 62	No	E – Yes S/I – Yes See p. 62
Meningococcus (*Neisseria meningitidis*)	Direct contact of HCWs' oral mucous membranes with infectious oral or nasopharyngeal secretions during mouth-to-mouth resuscitation or as a result of a spray of secretions within 7 days of onset and up to 24 hours after the start of effective therapy.	Yes See p. 67	S/I – Yes See p. 67	S/I – Yes See p. 67

Legend: E – Exposed, C/S/I – Colonized or Symptomatic or Infected

Table IV: Summary Table

Disease	Exposure Definition	Prophylaxis for E	Treatment for C/S/I	Work Restrictions E or C/S/I
Mumps	Direct or droplet contact of oral or nasal mucous membranes of a susceptible HCW with infectious saliva during the 2 days before and up to 9 days after the onset of parotid swelling.	No	No	E – Yes S/I – Yes See p. 71
Parvovirus B 19	A susceptible HCW having direct or droplet contact of oral or nasal mucous membranes with infectious respiratory secretions.	No	No	E – may consider in the care of specific patients See p. 76
Pediculosis (Lice)	Exposure to head lice defined as direct or indirect hair-to-hair contact with a patient infested with head lice prior to 24 hours of effective treatment; body lice exposure is defined as direct skin-to-skin contact or skin contact with clothing or bedding of an infested person prior to 24 hours of effective treatment. Crab lice transmission is not applicable in an OH setting.	No	S/I – Yes See p. 80	S/I – Yes See p. 80
Pertussis (Whooping Cough)	Droplet contact of oral or nasal mucous membranes with infectious respiratory secretions, face-to-face contact greater than 5 minutes with an infectious individual, or sharing the same confined air space, i.e being within 1 m (one metre) of an infectious individual for longer than 1 hour[233].	Yes See p. 85	S/I – Yes See p. 85	E – Yes if no prophylaxis S/I – Yes See p. 85
Rabies	A non-immune HCW being bitten by a patient or animal with rabies; direct contact of non-intact skin or mucous membranes with saliva, CSF or brain tissue from a patient or animal with rabies; inhalation of aerosolized virus in a laboratory.	Yes – Consult infectious diseases specialist and public health authorities	No	N/A

Legend: E – Exposed, C/S/I – Colonized or Symptomatic or Infected

Table IV: Summary Table

Disease	Exposure Definition	Prophylaxis for E	Treatment for C/S/I	Work Restrictions E or C/S/I
Respiratory infections	Droplet or indirect contact of oral, nasal, or conjunctival mucous membranes with infectious respiratory secretions.	No	S/I – No for most – dependent on etiology	S/I – Yes See p. 155
Rubella (German measles)	Direct or droplet contact of oral or nasal mucous membranes of a susceptible HCW with infectious respiratory secretions during the period from 7 days before onset of symptoms to 7 days after symptoms appear.	Yes	No	E – Yes S/I – Yes
Congenital rubella syndrome (CRS)	A susceptible HCW having droplet, direct or indirect contact of oral or nasal mucous membranes with the respiratory secretions or urine of an infant with congenital rubella syndrome.	See p. 91		See p. 91
Salmonella typhi	A susceptible HCW having direct or indirect oral contact with infectious feces; exposure may also occur with ingestion of contaminated food or water.	No	C/I – Yes See p. 94	C/I – Yes See p. 94
Scabies				
Typical	Direct skin-to-skin contact with an infested patient before treatment and until 24 hours of effective treatment.	No	S/I – Yes See p. 98	S/I – Yes See p. 98
Norwegian	Minimal direct and indirect contact with an infested patient before treatment and until 24 hours of effective treatment. Only minimal contact is required because of the large number of mites present on the source.	Yes See p. 98	S/I – Yes See p. 99	E – Yes S/I – Yes See p. 99

Legend: E – Exposed, C/S/I – Colonized or Symptomatic or Infected

Table IV: Summary Table

Disease	Exposure Definition	Prophylaxis for E	Treatment for C/S/I	Work Restrictions E or C/S/I
Staphylococcus aureus (*S. aureus*)				
A) Methicillin-sensitive *S. aureus* (MSSA)	Direct or indirect contact of non-intact skin or mucous membranes with MSSA infected body sites, wound drainage or respiratory secretions.	No	S/I – Yes C- Yes if epidemiologically linked to transmission See p. 104	S/I – Yes C – Yes if epidemiologically linked to transmission See p. 104
B) Methicillin-resistant *S. aureus* (MRSA)	Direct or indirect contact of non-intact skin or mucous membranes with MRSA colonized or infected body sites, wound drainage or respiratory secretions.	No	C/S/I – Yes See p. 109	C/S/I – Yes See p. 109
Streptococcus, Group A (GAS)	Droplet, direct or indirect contact of oral or nasal mucous membranes or direct contact of non-intact skin with infectious respiratory or wound secretions from patients with invasive disease (necrotizing fasciitis, toxic shock syndrome, meningitis, pneumonia or any form of GAS that results in death) from within 7 days prior to the onset of GAS until 24 hours of effective antibiotic therapy.	Variable - by provincial/ territorial guidelines See p. 115	S/I – Yes C – Yes if epidemiologically linked to transmission See p. 115	S/I – Yes C – Yes if epidemiologically linked to transmission See p. 115
Tinea (Ringworm)	Direct or indirect skin contact with infectious skin or scalp lesions or contaminated environmental surfaces.	No	S/I – Yes See p. 120	S/I – Yes See p. 120
Tuberculosis (TB)	Refer to *Guidelines for Preventing the Transmission of Tuberculosis in Canadian Health Care Facilities and Other Institutional Settings*[17]; *A National Consensus on Guidelines for Establishment of a Post-Exposure Notification Protocol for Emergency Responders*[19], *Canadian Tuberculosis Standards*[321], related provincial/territorial recommendations.	No	S/I – Yes	I – Yes if infectious pulmonary TB

Legend: E – Exposed, C/S/I – Colonized or Symptomatic or Infected

Table IV: Summary Table

Disease	Exposure Definition	Prophylaxis for E	Treatment for C/S/I	Work Restrictions E or C/S/I
Vancomycin-resistant enterococcus (VRE)	Direct or indirect contact of hands or skin with feces, urine, wound drainage, or areas of colonized skin of an infected or colonized patient.	No	No	C – Yes if diarrhea present See p. 125
Varicella-zoster virus (VZV)				
A) Varicella (Chickenpox)	A susceptible HCW inhaling airborne virus from an infectious patient, having face-to-face contact with an infectious patient, spending 1 hour in the room with an infectious patient or by direct or indirect contact of oral or nasal mucous membranes with vesicle fluid or respiratory secretions from an infectious patient 2 days before onset of symptoms and until all lesions have crusted over.	Yes See p. 132	S/I – Yes See p. 133	E – Yes S/I – Yes See p. 133
B) Herpes zoster (Shingles)	Direct or indirect contact of oral or nasal mucous membranes of a susceptible HCW with vesicle fluid of an infectious patient; additionally, exposure to disseminated herpes zoster defined as a susceptible HCW being in an enclosed airspace with an infectious patient, e.g. same room, or having face-to-face contact with an infectious patient.	Yes See p. 137	S/I - Yes See p. 137	E – Yes S/I – Yes See p. 137
Viral hemorrhagic fever (VHF)	Refer to *Canadian Contingency Plan for Viral Hemorrhagic Fevers and Other Related Diseases*[13] and related provincial/territorial recommendations.	No	S/I – Consult infectious diseases specialist and public health authorities	S/I – Yes

Legend: E – Exposed, C/S/I – Colonized or Symptomatic or Infected

– Appendix I –
Guideline Evidence-Based Rating System

I. Current Rating System for Recommendations

In the past, five categories have ranked the strength of the evidence that exists with respect to a recommendation. Categories A and B supported the recommendation, C was neutral, and D and E indicated evidence against the recommendation. Three grades described the quality of the supportive studies[480]. This format uses an evidence-based medicine approach that stresses the examination of evidence from clinical research, and well-designed experimental and observational studies, and places less emphasis on intuition and recalled experiences.

To simplify and clarify the categories, A, B, and C will be used in this document to support a recommendation for or against use. For Category C, the word “insufficient” replaces “poor”. The quality of evidence will continue to have the same grades. This system is outlined in Table V.

Table V: Strength and Quality of Evidence for Recommendations

Categories for strength of each recommendation	
Category	**Definition**
A	Good evidence to support a recommendation for or against use.
B	Moderate evidence to support a recommendation for or against use.
C	Insufficient evidence to support a recommendation for or against use.

Categories for quality of evidence	
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.

When regulations are quoted no rating is given as they are a legislative requirement.

– Appendix II –
Literature Review of Bloodborne Pathogen Exposures to Health Care Workers and their Control Measures

Appendix II describes (1) the results of a detailed literature review of occupational incidents related to sharps injuries, mucocutaneous splashes, and bites to HCWs that have the potential for bloodborne pathogen exposure and (2) the effectiveness of control measures. This background is essential for the prevention and management strategies needed to reduce the transmission of hepatitis B, hepatitis C, and HIV to HCWs in the workplace. Further information on the analysis of data collection concerning HCWs exposed to bloodborne pathogens at Canadian sites will be found in Appendix III, page 222.

Risk assessment, control measures, education, and evaluation of bloodborne pathogens are covered in Section B: Grouped Diseases, Bloodborne Pathogens, page 157.

1. Efficiency of Transmission of Bloodborne Pathogens

Hepatitis B is transmitted more efficiently than hepatitis C, and both are transmitted more efficiently than HIV, as is demonstrated in Table VI.

Table VI: Efficiency of Transmission of Bloodborne Pathogens

Risk Type	HBV	HCV	HIV
Risk of transmission following needlestick exposure	1%-6% if HCW is susceptible and the source is hepatitis B "e" antigen negative[392,404]	1.8% (0%-7%)[426]	0.3 %[394,396,450-452]
	19%-40% if HCW is susceptible and the source is hepatitis B "e" antigen positive[392,404-406]	10%[438]	
Risk of transmission following mucous membrane exposure	unknown	unknown	0.09 %[396,405]

2. Occupational Groups at Risk of Exposure to or Transmission from Blood and Body Fluids

It is difficult to compare rates of exposure to blood and body fluids among specific groups of HCWs, as there is no standardized denominator. Various reports include injuries per 100 full time employees (FTE), per 1,000 patient days, per 100,000 procedures[84], or per 100,000 hours worked[411]. Data from the 70 hospitals (two-thirds community hospitals and one-third teaching hospitals[481]) participating in the Exposure Prevention Information Network (EPINet) indicate that the average rate of reported sharp object injuries is 30/100 occupied beds per year[82]. Many studies cite percentages of injuries reported per worker group, as the rate is not available.

Nurses are members of the largest HCW group, and many studies have reported that they receive the most percutaneous injuries. When rates are calculated, however, other HCW groups have a higher rate of injuries. For example, phlebotomists have 39% as many documented seroconversions to HIV as nurses, despite working in an occupational group only 5% as large as the nurses' group. Phlebotomists also tend to perform higher-risk activities than nurses, e.g. drawing blood routinely rather than giving intramuscular injections. Thus phlebotomists are a higher risk group than nurses for occupational bloodborne pathogen infections[482]. Some studies indicate that physicians may have a higher rate of injury than nurses, but the injury is seldom reported[47]. In Italy, the highest rate of exposure in the nationwide hospital network occurs among surgeons (12.06/100 FTE) followed by midwives (11.33/100 FTE) and nurses (11.00/100 FTE)[115].

Seventy-six percent of Canadian surgeons who responded to a recent survey had had an exposure to blood or body fluids in the previous year[483]. Seventy-one percent of surgeons who responded to a survey had had a percutaneous injury, and 45% had had a blood mucocutaneous splash during the previous year. Nineteen percent of the percutaneous injuries were from hollow-bore needles and 22% were from cuts; the remainder were caused by suture needles (67%). Respondents reported a mean of 4.2 percutaneous injuries and 2.2 mucous membrane splashes in the previous year[483].

2.1 Nurses receive the most percutaneous injuries in Canada

In a Winnipeg study in 1990, Yassi et al reported occupational exposures indicating that nurses had received 82% of the injuries; laboratory personnel 6.2%; housekeeping, laundry,

central supply, and maintenance 5.7%; interns, residents and medical students 3%; and respiratory and radiology technologists 3%[411]. These percentages are similar to a previously conducted study[56]. Some workers, e.g. laundry workers, do not use sharps: their injuries are all due to the careless handling and disposal of sharps by others. When rates are examined, nurses working on medical wards had the highest rate of injury (14.23/100,000 hours worked) followed by nurses on the intravenous team, blood bank employees, and total parenteral nutrition nurses (10.09 injuries /100,000 hours)[411].

A Montreal acute care hospital study of three large university affiliated hospitals and two community hospitals in 1991-1992 indicated that nurses, as a group, had the highest rate of exposures to blood and body fluids (18 per full time employee year); licensed practical nurses had 12, radiology technicians 10, clinical laboratory technicians 8, and nursing assistants and housekeeping staff had 6 exposures per full time employee year[76].

A non-hospital study in community service centres and home care, conducted in Montreal from 1992 to 1993, indicated that 80% of all exposures to blood and body fluids were to nurses, and 92% of all needlestick injuries were to nurses[412].

Community nurses may be at increased risk for injury when compared with hospital workers, as they are less able to control the work environment. Poor lighting, furniture that cannot be adjusted, cluttered work area, and working alone with clients who may be confused enhances the likelihood of sharps injuries in the home[47,484]. A study conducted from 1993 to 1998 of some 84 hospitals and their physicians' offices and outpatient clinics in the EPINet database showed that health care professionals in office settings had 29% of high-risk injuries, e.g. from phlebotomies, whereas in the hospitals 24% of the injuries were in the high-risk category[485].

The Canadian *National Surveillance of Occupational Exposure to the Human Immunodeficiency Virus* reports worker-documented exposure to HIV positive blood through parenteral or mucous-membrane exposure or direct contact with non-intact skin. Nurses have 75% of all exposures to HIV from needlestick injuries voluntarily reported to Health Canada. Table VII demonstrates documented HIV exposures by occupational group and type of injury since 1985 as of December 31, 2000[397].

Initial results from 12 sites across Canada that are part of the Canadian Needle Stick Surveillance Network are given in Appendix III.

2.2 Nurses receive the most percutaneous injuries in the United States

In 1986, one of the first comprehensive studies of needlestick injuries was conducted at the University of Virginia Hospitals in the U.S. The most frequently reported needlestick injuries occurred to nurses and nursing students (64%), personnel in radiology and respiratory therapy (20%), housekeeping personnel (8%), and physicians and medical students (3%)[37].

A U.S. study of 77 hospitals reporting to EPINet over a 3-year period (1993-1995) found that the most frequent injuries occurred to nurses (51%), who perform many procedures

Table VII: HIV Reported Exposures by Occupational Group

	Nurse			Therapist/ Technician			Student/ Resident			Laboratory Technician			Physician			Other				
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	Total	%
Needlestick	320	75%	66%	16	4%	47%	21	5%	78%	27	6%	47%	26	6%	62%	17	4%	40%	427	62%
Surgical Instrument wound	19	47%	4%	1	3%	3%	3	8%	11%	6	16%	10%	4	11%	10%	7	18%	16%	40	6%
Mucous membrane	46	62%	10%	8	11%	24%	2	3%	7%	9	12%	16%	5	7%	12%	5	7%	11%	75	11%
Skin contact																				
a) Intact	6	40%	1%	1	7%	3%	0	0%	0%	2	14%	3%	2	14%	5%	4	29%	10%	15	2%
b) Non-intact*	60	67%	12%	5	6%	15%	1	1%	4%	12	13%	21%	5	6%	12%	7	8%	17%	90	13%
c) unknown	34	79%	7%	3	7%	9%	0	0%	0%	2	5%	3%	0	0%	0%	4	9%	10%	43	6%
Total	485			34			27			58			42			44			690	100%**
% of total injuries	70%			5%			4%			8%			6%			6%			100%	

* Previous tables had a separate heading called 'Open Wound Contamination' which has now been combined with 'Nonintact Skin Contact' exposures.

** Percentages in the table have been rounded.

A = number of injuries

B = % of this type of injury for this worker category compared with all workers' injuries of this type

C = % of this type of injury compared with all injuries for this category of worker

Source: National Surveillance of Occupational Exposure to the Human Immunodeficiency Virus (HIV)
Division of HIV/AIDS Epidemiology and Surveillance, Bureau of HIV/AIDS, STD and TB, Health Canada
Date: December 2000[397]

with syringes and needles, and phlebotomists (19%), who withdraw blood routinely (a higher risk activity as the needle or catheter is filled with blood)[481].

2.3 Students are at higher risk for injuries in Canada

Students in health care are at risk of exposure to bloodborne pathogens, but the rates vary considerably.

A Canadian retrospective survey of needlestick injuries demonstrated that, in two hospitals, ward-related injuries of house officers were highest in final year medical students (0.97/person year) and decreased to 0.42/person year for third year residents. Those with no ward-related injury in the first year had a 14% risk of injury in subsequent years. Those with at least one injury had an average risk of injury in the subsequent year of 54%. Seventy-six percent of medical and 100% of surgical house staff sustained at least one injury by the end of their internship. Forty-five percent of surgical staff (1.4/person year) were injured in their student year whereas 3.7/person year were injured as interns and 5.4/person year were injured as residents[486].

Yassi et al, in Winnipeg, found that of all reported occupational exposures in 1990 nursing students received 3.5% or 9.03 injuries/100,000 hours worked[411].

In a Montreal hospital study, nursing students received 2.5% of the exposures to blood and body fluids[76].

Canadian health care students reporting to the *National Surveillance of Occupational Exposure to the Human Immunodeficiency Virus* received 4% of the injuries[397].

2.4 Students are at risk for injuries in the United States

Thirty-five percent of responding fourth year U.S. medical students sustained one or more sharp injuries during their clinical training over a 10 month period. Sixty-nine of the injuries were in surgery (60% in the operating room and 34% in patient rooms). Seventeen percent of the injuries that were classified as high risk were caused by hollow-bore, blood-filled needles[478].

A 1998 survey of half of all U.S. dental schools indicated that third and fourth year dental students had 62.5% of the reported exposures, although they made up only 35.4% of dental HCWs. This represents a rate of 10.6 reported injuries/100 person years[487].

2.5 Dentists in Canada are at risk for injuries

Dentists are a group at risk of exposure to bloodborne pathogens. McCarthy et al reported that 67% of dentists responding to a 1995 Canadian national survey of dentists stated that they had had either a percutaneous or mucous membrane exposure (62% and 29% respectively of all responders) during their work in the previous year[488].

3. Equipment/Devices Associated with Percutaneous Exposures

Many devices used in health care can cause percutaneous exposures. In a case-control study by the CDC, there was a higher risk of HIV transmission with large, hollow-bore devices, e.g. those used to draw venous or arterial blood, than with solid devices such as suture needles[395]. The hollow-bore devices contain undiluted blood that increases the exposure of the HCW to HIV, especially if the person is in the terminal stages of AIDS, when the viral titre is high. In this case, the risk of seroconversion is higher than the average risk of 0.3%[395]. The risk of transmission of HIV to the HCW was 4.3 times higher if the procedure involved a needle in the artery or vein, e.g. phlebotomy, insertion of an intravenous catheter, or arterial blood gas collection than if the procedure was an intramuscular injection or an injection into an intravenous catheter. The risk of transmission of HIV was 6.2 times higher if there was visible blood on the device. A deep injury, a deep puncture or wound with or without bleeding was 15 times more likely to transmit HIV than if the injury was superficial[395]. The type of device and the procedure involved changes the risk of exposure to bloodborne pathogens and transmission of disease to the HCW. These two factors are important to consider when committees and staff choose safer equipment.

EPINet is one of the largest standardized surveillance databases and contains information about bloodborne pathogen exposures in more than 70 hospitals. In its 1993-1995 study, 36% of percutaneous injuries were caused by syringes with a hollow-bore needle, a lower risk device when used for intramuscular and subcutaneous injections[481].

Examples of devices involved in higher risk injuries include intravenous catheter stylets (6%), needles on intravenous lines (5%), butterfly needles (5%), and phlebotomy needles (5%), as these hollow-bore needles may contain blood. Of the high-risk injuries reported in 1993-95, 13% were caused by needles used to draw venous blood, 3% of injuries were from needles used to draw arterial blood, and 7% were caused by needles used to set up intravenous or heparin/saline locks[481].

In Italy, the highest risk of exposure from with winged steel needles and intravenous catheter stylets[115].

Needles removed from proximal ports of central venous lines and heparin-locks are more likely to contain occult blood than those from peripheral lines and distal ports of central lines without visible blood[489] and therefore carry a higher risk of disease transmission.

Accessing the heparin intravenous lock has been associated with increased risk of injury. In a Winnipeg study, this procedure was responsible for 26% of all needlestick exposures[56].

In home care, implanted ports are one of the most commonly used vascular devices[490]. The nurse must remove the needle from the port at the end of the infusion therapy, and there is a high resistance and drag on the needle when it is withdrawn. Since the nurse's hands must stabilize the port during the process and a blood-filled needle is withdrawn from the port, the risk of injury is increased[490]. EPINet data indicate that 48% of injuries using the Huber needle, which attaches to the port, happen when the needle is withdrawn, causing skin puncture and some bleeding[490].

In an early study, disposable syringes caused the most frequent injuries in a university hospital, but devices requiring disassembly had rates of injuries that were five times higher[37].

Based on the rate of injuries per 100,000 devices, vacutainers, butterflies, and IV catheters posed a higher risk of injury than hypodermic needles in a five-hospital study of acute care hospitals in Montreal[76]. There was a higher risk of butterflies and vacutainer injuries per 100,000 devices than of injuries from hypodermic needles in a Montreal non-hospital study[412].

4. Circumstances Associated With Percutaneous Exposures

Needlestick injuries can occur any time that needles are manipulated. Injuries with sterile needles before they are used on the patient do not present a risk for bloodborne pathogen transmission. Injuries that occur with a needle that is inserted into an intravenous line not related to blood products are usually very low-risk injuries.

The needlestick injuries that occur during procedures carried out on patients carry a higher risk and are difficult to prevent because the patient may move suddenly. Even in these cases, the use of a safer intravenous catheter to establish the line may be helpful. Needlestick injuries after use are preventable with engineering controls by, for example, a phlebotomy tube with a needle that retracts after the procedure.

In one of the original studies conducted at the University of Virginia Hospitals in 1986, 16% of needlestick injuries occurred before or during use, 70% after use and before disposal (mostly with recapping), and 14% during or after disposal[37].

Table VIII demonstrates the number of injuries that occurred according to their timing, as taken from the 1993-94 EPINet database[77].

In the 14 years in Canada that the *National Surveillance of Occupational Exposure to the Human Immunodeficiency Virus*[397] has been collecting data, 29% of the preventable exposures occurred during recapping, 19% were a result of improper disposal of a used needle, and 52% occurred during skin contact, i.e. open wound contamination and non-intact skin contact.

Difficulties arise when doses of drugs are given sequentially to an individual patient from the same syringe, and this process requires the needle to be recapped or changed often. At a hospital in Toronto an ophthalmologist sustained an injury to the index finger from a patient with HIV while changing needles for an anesthetic injection[491].

Other studies report the circumstances of the injuries. In a 2 month study of fourth year medical students, ending in 1996, it was found that injuries occurred most frequently in the clinical surgical rotations. Of the 24 injuries, 34% were inflicted by another HCW, usually while holding retractors or retracting tissue with their hands[478].

Exposure to blood or body fluids can occur in any work area. In a 1992-1994 EPINet study, injuries of clinical laboratory workers were compared with exposures in the hospital outside the laboratory. Fifty-one percent of needlestick injuries caused by blood-drawing needles were in the clinical laboratories and only 23% in patients' rooms[492]. Thirty-nine percent of all glass

Table VIII: Timing of Injury in Relation to Device Used

	Number and Percentage of Injuries						
Device	**Before Use**	**During use**	**Recapping**	**Before Disposal**	**Putting Device Into Disposal Container**	**Other**	**Total**
Hollow-bore needles and disposable syringes	8	54	41	74	28	97	302
	2.7%	17.9%	13.6%	24.5%	9.3%	32%	100%
Hollow-bore needles and prefilled cartridge syringes	0	9	2	10	2	12	35
		25.7%	5.7%	28.6%	5.7%	34.3%	100%
Hollow-bore needles and arterial blood gas syringes	0	6	2	3	0	7	18
		33.3%	11.1%	16.6%		39%	100%
Hollow-bore needles on intravenous systems	0	18	6	16	4	56	100
		18%	6%	16%	4%	56%	100%
Hollow-bore winged steel needles (butterfly)	0	10	1	11	11	10	43
		23.3%	2.3%	25.6%	25.6%	23.2%	100%
Intravenous catheter stylets (tubing stays in vein)	0	6	1	18	3	11	39
		15.3%	2.6%	46.2%	7.7%	28.2%	100%
Vacuum tube/phlebotomy hollow-bore needles	1	11	2	20	5	8	47
	2.1%	23.4%	4.3%	42.6%	10.6%	17%	100%
Lancets	1	8	0	11	3	14	37
	2.7%	21.6%		29.7%	8.1%	37.9%	100%
Suture needles – physicians	0	37%–90.2%	0	1%–2.4%	0	3%–7.3%	41%–100%
Suture needles – nurses	2%–5%	9%–22.5%	0	5%–12.5%	2%–5%	12%–3%	40%–100%
Scalpel blades – physicians	0	12%–60%	0	3%–15%	0	5%-25%	20%–100%
Scalpel blades – nurses	1%–4.5%	0	0	4%–18.2%	1%–4.5%	16%–72.8%	22%–100%

Source: 1993-4 EPINet database[77].

injuries were in the laboratories, as compared with 0.3% in patient rooms. The EPINet study also examined injuries caused by conventional intravenous catheter stylets and 73 safety intravenous catheter stylets. As many as 47% of the conventional intravenous catheter injuries occurred in patient rooms, as compared with 11% in the emergency department[482].

Canadian surgeons are at higher risk of percutaneous exposure to bloodborne pathogens if they are younger, have a high work load, work in a community or regional hospital, and do not use "no touch" techniques[483].

Canadian dental staff are most likely to be exposed to patients' blood or saliva through percutaneous injuries in laboratory work, clean-up, and instrument preparation[493]. Other studies indicate that dental burs are the most frequent cause of injuries in dentistry[488].

5. Underreporting of Exposures by HCWs Has Been Widely Documented

An old study in a small U.S. university hospital by Hamory indicated that 40% of HCWs had not reported their exposures during the 3 months before the survey, and that 75% of personnel had not reported their injuries over the previous year[494].

In 1990, McGeer, Simor, and Low reported that only 5% of final year medical students, interns, and residents at the University of Toronto reported percutaneous injuries[486].

In a five-hospital Montreal study, anonymous reporting of injuries to researchers was compared with the injuries reported to the health service. Additionally, staff reported exposures in a questionnnaire survey at the end of the study year. Overall, 47% of potential bloodborne pathogen exposures were not reported to either the research team or the health service; 34% of workers did not report any of their percutaneous injuries to the health service, and up to 75.1% did not report their mucocutaneous exposures to the health service[495].

A similar, non-hospital study in Montreal indicated an underreporting rate of 38.5% for percutaneous exposures[412].

From 1992 to1994, four hospitals contributing to the EPINet database participated in enhanced surveillance. The results indicated that only 10% of percutaneous injuries and 7% of muco-cutaneous injuries that were reported to EPINet were reported to Occupational Health and Safety Administration (OSHA), as per the legal requirement[496].

In the medical schools at the University of Virginia, the results of a survey of fourth year medical students in 1999 reporting their experience with exposures to blood and body fluids were compared with the health service records. Only 43% of the students with injuries reported the injury to the health service[478].

Overall, 46% of needlestick injuries were not reported from Phase I to Phase II of the 1993-95 study of six hospitals undertaken by CDC to evaluate safer phlebotomy devices[465]. Underreporting of needlestick injuries was documented in two surveys, and the results varied from 9% among phlebotomists, 32% among nurses, 65% among medical students, and 69% among residents (medical, pediatric, and surgical).

A follow-up retrospective survey of individual dental students in a 1998 study at a U.S. dental school indicated that 68% did not report percutaneous and mucosal exposures[487].

5.1 Many reasons are cited for underreporting

HCWs do not always realize that they have had an exposure to blood and body fluids. An Australian prospective study indicated that 44% of eye shields used in surgery tested positive for blood, but the surgeon was aware of a spray episode in only 8% of the cases[497].

Some of the reasons HCWs give for not reporting injuries indicate that they consider the event to be a low-risk one, e.g.

- the injury was not serious[487],
- the patient was healthy[487].

Another reason for not reporting exposure is that the HCW felt guilty because she or he had had an injury, e.g.

- self-blame on the part of the HCW injured[498],
- perceived loss of status in the workplace or the academic hierarchy[499],
- concern about job security during a time of downsizing[498], and
- perception of carelessness by the employee conveyed by the person who takes the report[498,499].

HCWs doubt the helpfulness of the person/institution to whom they report, e.g.

- problems with confidentiality[487],
- disciplinary action[490],
- a negative clinical evaluation[487],
- a critical, unsupportive attitude by direct management[398,490,499],
- lack of support by the larger organizational body[83,499],
- lack of consistent "team spirit" support from co-workers[490,498,499],
- perceived reluctance of administrators to track transmission of disease from patient to worker[498],
- dissatisfaction with follow-up procedures[500].

HCWs experienced organizational difficulties or operational procedures, e.g.

- working environment was crowded or unsafe at the time of the injury[499],
- health centre was not open at the time of the injury[398],
- HCW was unaware of postexposure protocols[501],
- HCW did not know how to report[398],
- it was too difficult to determine the status of the source[398],
- method of reporting was more difficult when the injury occurred in the home than in the hospital[47],

- the equipment was faulty or insufficient[499],
- lack of time[83,398,487]
- lack of involvement in selecting and evaluating equipment[498].

5.2 Some studies have looked at methods to increase reporting

The more complete the policies and procedures are for postexposure follow-up, the more injuries are reported. In Montreal, hospitals with the best postexposure measures had the lowest rates of underreporting[76,495].

Standardization of postexposure procedures may increase satisfaction and decrease waiting times, so that staff report injuries even if they are busy[500]. Increased education may highlight the need to report injuries as a result of a better understanding of the risk[500].

In Australia, an educational program as well as the testing of a new safety device resulted in 26% of needlestick injuries being unreported, whereas 64% were not reported before the start of the program[502]. The importance of repetition of the educational program was stressed, although it was not a part of this process.

6. Cost of Percutaneous Exposures

Of the many consequences of needlestick injuries, financial cost is a significant one. Costs include assessment of the source (including laboratory testing), employees' lost time from work, post-exposure counselling and assessment, laboratory testing, prophylaxis, and follow-up. Even when the source individual is found to be negative for bloodborne pathogens, needlestick injuries may have a negative psychosocial impact on the employee.

In 1995, Yassi et al estimated the cost of a needlestick injury in a Winnipeg hospital, without postexposure prophylaxis for HIV, to be from $80 to $560[88].

In 1999 in Canada, the cost for a 28-day course of a triple-drug postexposure prophylaxis regimen for HIV was $1,100, including blood test costs[491].

The average cost of a needlestick injury in 1995 in the U.S. when the source was found to be negative for hepatitis B, hepatitis C, and HIV was $200. This estimate included laboratory costs, immunization costs, and OH staff and employee time. If the source was positive for all three bloodborne pathogens, the cost, as described above, ranged from $860 (no zidovudine) to $2,000 (including zidovudine)[503]. Another estimate was $1,440 U.S. for triple therapy for HIV[490], including laboratory work for both the source and employee, and OH staff and employee time.

Not all exposed employees who should have postexposure prophylaxis according to the protocol take it. In 1996-97 in Boston, of the 66 employees who agreed to take the drugs after notification of a positive HIV source patient, 31 (47%) discontinued them because of side effects[504]. Failure to complete the recommended drug regimen may have other costs if employees become infected with a bloodborne pathogen.

Two of the 70 hospitals in the EPINet reporting group, one a community hospital and the other a university hospital, estimated the cost of exposures and found that mucocutaneous exposure cost about the same amount as percutaneous exposure in each of the two hospitals[505].

The psychosocial effects on the HCW of a potential exposure to bloodborne pathogens cannot be underestimated. A study done at the San Francisco General Hospital highlights this impact: 42% of the 700 workers assessed at the time of pre- or post-HIV testing at that hospital needed additional professional or peer support. Surprisingly, 35.2% of referrals were for HCWs whose source patients had tested HIV negative. Both the occupational injury and previous losses may lead HCWs to feel less control and pass through a period of mourning[499].

Safer devices may replace existing equipment without extra money being spent. In a Winnipeg study, changes to make equipment safer were accomplished that resulted in lower costs for needlestick injury follow-up. The total estimated overall cost saving varied, depending on the amount of new equipment that was used, the decrease in disposal costs, and the cost of employee follow-up. The change to safer equipment could have saved 5.3% but may have cost 5.7% more as a result of an increased demand for the newer, more expensive equipment[88].

Compensation paid to HCWs who seroconvert as a result of an occupational injury is costly in terms of finance and ability to attract workers. In the U.S., HIV was transmitted to an intern via a needlestick injury, and the award paid to him was $1.3 million[474]. Doctors are not bound by Workers' Compensation Agency rules.

7. Prevention of Exposures to Bloodborne Pathogens

Injuries from unnecessary needles and all injuries from hollow-bore needles are preventable HCW injuries. According to this definition, 81% of the hollow-bore needle injuries reported in the 1993-95 EPINet analysis were preventable[481]. Safer devices[37,106,506], a reduction in the use of invasive procedures, a secure work environment, and an adequate staff-to-patient ratio[66] are recommended to increase worker safety.

8. Effectiveness of Engineering Controls to Decrease the Exposure to Bloodborne Pathogens

Early attempts to control exposures to blood and body fluids focused on the use of safety guidelines and education. However, evidence indicated that this did not lead to fewer needlestick injuries. Engineering controls were recommended as a more effective way to control HCW exposures to blood and body fluids[37]. Studies at the University of Virginia suggest that the redesign of hollow-bore needle devices incorporating safety features that eliminate unnecessary needles or that shield hands from used needles might prevent over 85% of needlestick injuries from these devices[77].

Active safety devices can reduce percutaneous injury rates significantly. When conventional phlebotomy devices were replaced with active safety devices in six hospitals in Minneapolis-St. Paul, New York City, and San Francisco, percutaneous injury rates were significantly reduced.

With one type of vacuum-tube blood-collection device, a reduction of 76% occurred, and with a second type a 66% reduction occurred. A reduction of 23% was achieved with the use of winged steel needles with a safety lock. Fifty-seven percent of the first type of vacuum-tube collection device were activated, as were 98% of the second type. Fifty-six percent of the winged steel needle devices were activated[465]. Further improvements could be expected with increased activation of the active safety devices or the use of passive devices.

In a prospective, randomized study of patients scheduled for surgery in Japan, an intravenous cannula that was actively retracted into the safety barrel before removal of the needle from the cannula resulted in no blood exposures when compared with injuries resulting from use of a traditional 18-gauge needle and syringe[507].

However, in other studies the active feature does not always provide protection, although reductions in injuries still occur. One CDC study on percutaneous injuries during phlebotomies showed 74% of the safety features for vacuum-tube blood collection needles and 60% of the safety winged steel needles were activated when devices in the safety disposal container were examined. With the active safety phlebotomy devices, 56% of HCWs sustained injuries before activation of the safety device was appropriate, 18% during activation, and 4% after activation. Twenty-two percent were not activated. At least 40% of percutaneous injuries were reduced during phlebotomies by the use of active safety devices[508].

In the five large teaching hospitals in the U.S. National Surveillance System for Hospital Health Care Workers for bloodborne pathogen exposures, 33% of injuries from hollow-bore needles used for blood collection were classified as not preventable with the technology that was used[509]. The authors stated that most percutaneous injuries are preventable, and many might be prevented with the use of passive devices.

The pilot testing of an active safety syringe indicates that greater HCW acceptance would be achieved if the safety device were a passive one[510]. Most times, the safety feature on a passive device activates. In a study of automatic retracting safety syringe and needles only 1% of the passive devices did not activate. The barrels in the syringes were not fully engaged, and so the safety feature was not initiated[511].

One method of reducing injuries is to blunt the sharp instrument. A model based on a 15-month study of blunt suture needles showed that the estimated odds of a percutaneous injury were reduced by 87% when 50% of the suture needles used were blunt[55].

An analysis of EPINet data showed that shielded-stylet safety intravenous catheters reduced intravenous catheter related needlestick injuries by 83%[82]. Bryce et al, in a study at the Vancouver General Hospital, estimated that safety syringes used for intravenous or subcutaneous injections could have prevented 19% of the moderate- or high-risk injuries and 12% of the low-risk injuries. In contrast, needleless intravenous infusion sets may have prevented 3% of the high-risk and 55% of the low-risk injuries[51].

Many needleless systems have been developed to meet the need to control injuries with a lower risk for disease transmission, e.g. needles used to access intravenous equipment, or for heparin/saline flushes or other intravenous line connections. Studies indicate the following results:

- The use of needleless access systems in a small, public teaching hospital in California reduced intravenous access related needlestick injuries by 54%[90]. Educational activities further reduced injuries by 18%.
- In a Winnipeg study, the use of a needleless access system reduced intravenous line related injuries by 78.7%. An overall reduction of 43.4% in total needlestick injuries from all procedures and events occurred. No longer recapping needles was responsible for a 40.6% reduction in injuries and a 40.7% reduction in injuries formerly caused by improper disposal of needles[88].
- Other studies have also found the needleless access system to be effective[89,512,513].
- These results contrast with one study carried out in New Zealand, where needleless access systems did not decrease percutaneous injuries[514].
- In a 6-month, six-hospital trial, a 3 mL shielded safety syringe and a needleless intravenous system reduced needlestick injuries by 61% when compared with the preceding 6-month period. The control group also had a similar reduction of injuries, and therefore the change was not effective[515].

In 1999, the 70 hospitals in the EPINet database report noted that 26% of needlestick injuries were due to accessing intravenous equipment, but only 3% involved accessing intravenous equipment after the implementation of needleless and protected needle intravenous systems[82].

An effort to reduce needlestick injuries by one U.S. university hospital, which switched to needleless systems and provided extra education and staff orientation as well as improved needle disposal containers, reduced the total number of injuries[49].

Sharps disposal units, a type of engineering control, placed on the walls near the patients in a major teaching hospital in California, reduced recapping by 27% in one unit and 18% in a second unit but made no significant difference when the box was near the patient but not on the wall[87].

Bryce et al, in a study at the Vancouver General Hospital, estimated that point-of-use sharps disposal containers could have prevented 21% of the high-risk injuries in which the device was contaminated with blood or an infectious body fluid[51].

Some users have questioned whether the newer safety devices cause more infections in the patients. The CDC states that short-term complications in patients are clinically minimal and long-term complications from phlebotomies were unusual, as phlebotomy devices are not indwelling[465].

Despite the potential for success, many hospitals participating in EPINet have not yet made the switch to safer devices. Jagger and Perry reported that in 1993-95 only 28% of hospitals had

switched to safer intravenous catheters, and less than 10% had switched to safer blood-drawing needles[82]. Data from five hospitals participating in the U.S. National Surveillance System for Hospital Health Care indicated that in 1998, 98% of devices that caused percutaneous injuries did not have safety mechanisms[84].

More health care facilities are likely to use safer devices now that the state of California has led the way in making it mandatory for needles and other sharps devices to have engineered sharps injury protection[516]. This move has since been followed by needlestick legislation in several other states, including Tennessee, Maryland, Texas, and New Jersey. Federally in the U.S., the Occupational Safety and Health Association revised the directive for the 1992 bloodborne pathogen standard to include the evaluation of health care facilities' use of safety-engineered devices in the measurement of the facility's performance. The National Institute of Occupational Safety and Health, part of the CDC, also urges employers to use safety engineered devices[516].

Many additional ideas have been generated to reduce bloodborne exposures to HCWs, as demonstrated in Table IX.

9. Effectiveness of Administrative Controls to Decrease the Exposure to or Transmission of Bloodborne Pathogens

An adequate ratio of patients to personnel should enable care to be given in a safer manner[66].

Following a blood and body fluid exposure, laboratory testing of the source blood, if the source is known, is recommended in order to accurately determine the appropriate follow-up for the HCW[12]. Testing for bloodborne pathogens is voluntary and requires informed consent. Empowering HCWs with a role in obtaining consent may improve the timeliness and proportion of source blood that may be tested following an exposure. In most Canadian hospitals (87.6%), it is a physician's responsibility to obtain consent for all HIV testing. A Calgary study carried out from 1989 to 1993 to assess an alternative system indicates that infection control practitioners' follow-up of known source patients with OH follow-up of employees could result in consent and testing for HIV and HBV respectively from 67.9% and 87.6% of low-risk patients and 82.3% and 92.2% of high-risk patients. Backup teams can successfully cover off-hours or areas where access to infection control practitioners is a problem[525]. This practice helps the employee to receive effective follow-up after a potential exposure to bloodborne pathogens.

A 1995 survey of a stratified, random sample of Canadian dentists indicated that 41% of respondents had a postexposure protocol[488]. Multiple logistic regression showed that a dentist who did not comply with the use of postexposure protocols was 1.7 times more likely to have a percutaneous exposure, taking age into account, than those who did comply with postexposure protocols[488].

Table IX: Safer Devices/Equipment to Decrease HCW Exposure to Bloodborne Pathogens

Device/equipment	Replaces	Advantage	Study
Single-use disposable nozzle for jet injectors	Multi-jet injector	Suitable for group immunizations	(517)
Disposable, single-use lancet that retracts into the holder	Non-retractable lancet	Effective for monitoring glucose levels	(518)
Slide preparation devices, sample collection cup, and a plastic finger-stick sampling blood collection tube	Need to open tubes of blood to obtain a sample	Decreases risk for laboratory workers working on blood samples	(519)
Blunt tip on the tip of a scalpel, skin clips or staples for skin closures and closure of the suture line with blunt suture needles and forceps	Sharp scalpel tips, sharp towel clips and cautery tips in the operating room	Decreases opportunity for sharps injury	(520)
Stapling allows rapid closing of the skin	Sutures	Hands are further away from the sharps	(521)
A retractable plastic sleeve for plastic syringes for local anesthetic	Reuse of needle and syringe with no protection	Allows their reuse and safe retention of the needle	(522)
Plastic capillary tubes, specimen tubes, and syringes	Glass tubes and syringes	Plastic will not break and expose the HCW to blood and potential bloodborne pathogens	(481,522-523)
A closed system, e.g. for angiographic flush	A splash from blood emptied into bowl	Eliminates blood splash	(522)
Port (Huber) needle removal devices, e.g. forcep is used to pull on a needle for containment and disposal in a protective device that fits on the hub of a port, or a small plastic box slides over the needle shaft allowing the top to be pushed down to stabilize the port and the HCW to pull up on either side of the device with the index and middle fingers to remove the needle in the box	Removal of Huber needle with hand	Prevents hollow blood-filled needle injury	(490)
Well designed, ergonomically suitable work station, e.g. phlebotomy station	Basic unit for blood drawing	Decreases the likelihood of injuries	(524)

10. Effectiveness of Work Practices to Decrease the Exposure to or Infection with Bloodborne Pathogens

10.1 Immunization

Hepatitis B immunization is 90% to 95% effective in immunocompetent persons. The production of antibodies is lower in people with HIV, renal failure, diabetes mellitus, chronic liver disease, smokers, and alcoholics. The response rate declines from 95% for a child < 2 years of age to 71% for someone between the ages of 50 to 59[8].

An intensive hepatitis B vaccination program in a Winnipeg hospital resulted in an increase of 13.6% of people vaccinated during the promotion period. In areas not targeted for immunization in the program there was a 6% decrease in overall vaccination rate, leading to the conclusion that self-initiated participation may be ineffective[411].

Analysis of a 1995 survey of a stratified, random survey of Canadian dentists indicated that 91% of dentists responding had been immunized against hepatitis B, and 72% had received the test results of antibody to hepatitis B surface antigen[488].

HCWs performing exposure-prone procedures are referred to the document *Proceedings of the Consensus Conference on Infected Health Care Workers: Risk for Transmission of Bloodborne Pathogens*[9].

10.2 Safer handling of sharp devices

It is not recommended to recap or otherwise manipulate used needles with both hands. If recapping cannot be avoided, either a single-handed “scoop method” or a mechanical device designed for holding the needle sheath should be employed[11].

Data from the EPINet database indicate that injuries due to recapping of needles has decreased from 25% to 4% over the last decade[82].

The literature recommends that the person who uses the sharp equipment is responsible for its disposal[11].

Multiple logistic regression of a 1995 stratified, random sample of Canadian dentists indicated that a dentist who did not comply with the use of sharps-disposal containers was 1.5 times more likely to have a percutaneous exposure, taking age into account, than those who used appropriate sharps containers[488].

Tissue retraction using a free hand is associated with increased injuries[526]. The following procedural changes in the operating room[11] have been associated with a decrease in injuries:

- using scissors instead of a scalpel[521],
- shielding the scalpel blade or using blade-removing accessories[526,527],
- clamping the sharp tip of a needle in a needle holder before returning it to a co-worker[526,527],

- holding the suture needle with forceps[526,527],
- increasing the length of the forceps or retractors to decrease the likelihood of striking the hand that holds the retractors[526],
- tying a suture with a suture thread that is sufficiently long that the needle is guarded by a needle holder and not the palm of the hand[526],
- using a cotton outer glove over the latex one when working with wire sutures[526],
- minimizing sharp equipment in the operative field unless it is being used, e.g. suture needles, needle holders, scalpels, hypodermic needles, and all other sharp instruments[526,527]; replace with blunt suture needles, stapling devices, or tissue adhesives[527].

Other work practice changes in the operating room[11] have been associated with a decrease in injuries:

- notification of the surgeon by the assistant before moving hands in the operative field[522],
- minimal access surgery, which reduces exposure of fingers and instruments that are in close proximity to wide, open wounds[521],
- the use of a "no-touch" or "hands-free" technique, which has been shown to decrease the risk of injury by 59% when blood loss was over 100 cc[439],
- a "safety-passing zone"[520], where sharp instruments are placed to avoid passing them directly to another HCW during procedures in the operating room or treatment room (a simple, effective method that has a very low cost)[51,483],
- adequate lighting in areas where procedures involving sharp instruments are performed, e.g. in the operating room and radiology unit[522], in order to enable direct visualization of the hands and instruments when the wound is being closed[526].

Implementation of hospital-wide availability of safety intravenous catheters rather than implementation in selective clinical areas only is more likely to prevent exposure[482].

The location of sharps-disposal bins at the point of use and disposal decreases the likelihood of injuries[87]. A Canadian Standards Association document states that the puncture-resistant container is to be filled to no more than three-quarters capacity. The standard is also in place for colour-coding, labelling, and strength[53]. Having bins available from pocket size to 26 L facilitates disposal appropriate to the workplace[528].

11. Effectiveness of Personal Protective Equipment to Decrease the Exposure to or Infection with Bloodborne Pathogens

The choice of personal protective equipment depends on the procedure to be done and the likelihood of being exposed to blood or body fluids[11].

Over a 2 year period, 1992-94, the 70 hospitals reporting to EPINet identified 76 mucocutaneous exposures in the clinical laboratories; 74% of these were reported as mucocutaneous exposure of

blood to areas of the face, including the eyes and nose, as compared with 54% of mucocutaneous exposures from blood in patient rooms[492]. Face shields that attach from the top of a mask rather than those that rest on the forehead and are open below provide more protection and improved visibility[522].

A mucocutaneous splash is most likely to occur when Canadian surgeons are younger, have a high work load, and do not use eye protection in the clinic or operating room[483].

Hospital operating rooms differ significantly from other sites in their frequency and types of blood exposure, and requirements for protective equipment[529]. Liquid-proof or liquid-resistant gowns or coats offer greater protection than cloth laboratory coats when there is a risk of splashing or spraying of blood or body fluids[492].

Glove material decreased the volume of blood transferred by hollow-bore needles in an in vitro (paper/tissue) model by a mean of 46% in an ex vivo (animal tissue) model by 63%, compared with no glove. The reduction in mean blood volume transferred from suture needles in both models was a mean of 86% when a single sterile latex glove was used as compared with no glove[100]. There was a trend towards increased protection with additional layers[100].

Mouthpieces and other ventilation devices offer protection during procedures in which exposure to respiratory secretions is likely, such as in mouth-to-mouth resuscitation[81].

Women dentists in Ontario are more likely to wear masks and eye protection than male dentists[530]. A 1995 national survey of dentists in Canada indicated that dentists who experienced splash exposures were twice as likely not to wear eye protection than those who routinely used eye protection, taking into account age and dental specialty[488].

Dentists who used gloves routinely reported fewer percutaneous injuries. McCarthy et al states: "It is clear that better compliance with barriers reduces the risk of occupational exposures and infection"[413].

12. Effectiveness of Education to Decrease the Exposure to or Infection with Bloodborne Pathogens

Health Canada's *Preventing the Transmission of Bloodborne Pathogens in Health Care and Public Services Settings*[11] stresses the importance of educating the worker before she or he starts employment in the workplace and the need for education to be repeated on an ongoing basis. Special work areas need the education to be adapted to their environment, e.g. emergency responders (ambulance, fire, and police). There are many types of adult learning methods, e.g. lecture, discussion, case study, demonstration, and simulation, which may be suitable for differing goals[93]. Often, educational efforts have not been evaluated, and others show ambivalent results. Some recent theories of changing behaviour indicate that the information used by the learner depends on the stage of readiness to change[91]. Therefore, it may not be learning the information that is the difficulty but the ability of the learner to put the information into practice. Hands-on training may enhance the worker's ability to apply the procedure that has been taught. However, education should be regarded as an important supplement and not a replacement for safer

engineered devices. Between 600,000 and 800,000 needlestick injuries occur to HCWs in the U.S. per year[399].

At the University of Cincinnati from 1986 to 1988, an educational program to reduce needlestick injuries emphasized the importance of not recapping, of sharps disposal containers, and the use of universal precautions. The only decrease, from 47 to 21 needlestick injuries per 1,000 employees, occurred in the nursing group, when recapping decreased in association with the installation of sharps disposal containers[468]. It was hypothesized that more needlestick injuries were reported after educational efforts, which may have been why the injury rate did not decrease.

In a retrospective study of sharps injuries over a 1 year period in Vancouver General Hospital, it was considered that retaining an education coordinator would provide the most cost-effective method of reducing injuries[51]. The study projected that 59% of high-risk injuries and 25% of low-risk injures could be prevented.

Skolnick et al found a decrease in needlestick injuries of 18% following an educational campaign[90].

A national survey conducted in Canada in 1995 showed that those dentists who attended continuing education courses on infection control for 10 hours or more were 6.3 times more likely to have excellent compliance for infection control measures[414]. Examples of the 18 infection control measures included hepatitis B immunization for themselves and their staff, a postexposure protocol for needlestick injuries or cuts, washing of hands, and using personal protective equipment.

In Ontario, female dentists were more likely than male dentists to have attended continuing education courses related to HIV/AIDS in the previous 2 years[530]. The work practices of the women dentists showed that they were more likely to wear masks and eye protection than their male counterparts. There were no significant differences between them with regard to gloves[530].

13. Effectiveness of Evaluation to Decrease the Exposure to or Infection with Bloodborne Pathogens

To be an advocate for a safer workplace, one needs as much supporting data as possible[82]. Underreporting of potential bloodborne pathogen exposures may lead to biased estimates of the rate of seroconversions, inaccurate conclusions about the cause of the injuries, lack of appropriate management of an exposure, including prophylaxis, and lack of knowledge of the effectiveness of postexposure prophylaxis[398,495].

After the Montreal study of blood and body fluid exposures in HCWs in hospital (1991-1992) and non-hospital settings (1992-1993) the recommendation was made to reinforce the reporting system by the use of a standard collection tool and by provision of postexposure services to all HCWs[76,412]. The implementation of a surveillance network of exposures was recommended to allow for the aggregation of all exposure data from health care settings, which would increase sample size, thus permitting more refined data analysis[76,412], and allow for improvement within

the institution[50]. Since this time, a surveillance system has been implemented in 16 hospitals in Quebec and 12 pilot sites across Canada (see Appendix III).

EPINet, a standardized surveillance system that analyzes injuries, is being conducted in at least seven countries. Data from about 70 hospitals in the EPINet database indicate that injuries from recapping of needles has decreased from 25% to 4% over the last decade[82]. Providing HCWs with feedback from the analysis of injuries is thought to be responsible for this change. This data collection also provides information indicating the effectiveness of a change in work practices or a change to safer engineered devices. Further corrective action may then be taken.

In addition, the U.S. National Surveillance System for Hospital Health is a surveillance system designed by the CDC to track bloodborne and vaccine preventable occupational exposures and infections among HCWs in 22 hospitals in the United States[531]. Although aggregate data showed a decline in percutaneous injuries due to winged steel needles and in the proportion of percutaneous injuries associated with blood withdrawal, examination of data from individual hospitals revealed no changes over time[532].

– Appendix III –
Canadian Needle Stick Surveillance Network (CNSSN)

Update – Surveillance Of Healthcare Workers Exposed To Blood/Body Fluids And Bloodborne Pathogens: 1 April, 2000 To 31 March, 2001*

Introduction

Healthcare workers (HCWs) in Canada exposed to human immunodeficiency virus (HIV) have been the subject of surveillance since September 1985. In January 2000, an integrated project combined the existing HIV occupational sharp exposure database with a hepatitis B virus (HBV) and hepatitis C virus (HCV) database held by the Bloodborne Pathogens/Nosocomial and Occupational Infections Division (BBP/NOID). The goal of the new Canadian Needle Stick Surveillance Network (CNSSN) is to monitor HCW's occupational exposures to blood or body fluids and follow subsequent seroconversions to bloodborne viruses (HBV, HCV, HIV).

This report presents the first year of surveillance data (1 April, 2000 to 31 March, 2001) from the CNSSN. At the time of this report, the Division is piloting the project with 12 hospitals across Canada (excluding Newfoundland, Quebec, Yukon and Nunavut territory). Quebec continues to maintain its own surveillance network; therefore, data from its 16 sites are not included in this report. Plans to

* This appendix is reproduced from the Canada Communicable Disease Report, December 2001[533].

recruit hospitals in other jurisdictions are underway. All participating network hospitals are listed in the Acknowledgements section.

Protocol

Hospital participation in the CNSSN is voluntary. Before and during the network implementation, participants receive 2 days training on the Windows système intégré de surveillance des expositions et des séroconversions (WinSISES) program, as well as continuing guidance from the BBP/NOID. WinSISES, developed by Dr. Pierre Robillard and Dr. Elise Roy, enables sites to manage data entry, do analyses, produce reports, follow-up exposed HCWs and transfer data to the network themselves. WinSISES was piloted in English and French hospitals during 1997-1999, it has been used for the last 4 years in 16 Quebec sites, and by the CNSSN since January 2000.

Exposures that are reported to a hospital's employee health services are collected and entered in two standardized computerized forms (Exposure Report Form and Worker Post-Exposure Follow-Up Form) provided by the WinSISES. Every 6 months, collaborating sites send anonymous data to the network for national compilation and interpretation. The following information is collected:

- *HCW*: Date and time of exposure, sex, job title and immunization against HBV.
- *Exposures*: Type, fluids involved, location, circumstances, body site, devices involved, reasons for using devices, stage of the work, depth of injury, piercing of protective materials, quantity of fluids, size of the skin surface exposed, duration.
- *Patient-source*: Identification, serologic status, risk factor, whether on antiretroviral treatment.
- *Management of exposed HCW*: Serologic status for HBV, HCV and HIV, use of post-exposure prophylaxis, adverse events of prophylaxis, symptoms of hepatitis and retrovirus.

Denominator data used to prepare the rates of exposure are supplied from the network hospitals. These data include: number of full time equivalents (FTEs), by job-type; number of hospital beds; number of patient-admissions; and, number of patient-days.

Data analysis

The analyses for this report were restricted to exposures at risk for transmission of bloodborne pathogens occurring between 1 April, 2000 and 31 March, 2001. These include percutaneous exposures (needle-stick, cut, scratch, bite) and mucocutaneous exposures (contact with mucous membrane of nose, eye, mouth or direct contact with non-intact skin) to body fluids such as: blood, serum, plasma, saliva, sperm, vaginal secretions, amniotic fluid, cerebrospinal fluid, pleural fluid, pericardial fluid, peritoneal fluid, synovial fluid, or other fluids visibly stained with blood.

Descriptive statistics and rates of exposure were calculated using the SAS version 8.1 (SAS Institute, Cary, NC). Rates were calculated based on different denominators including: number of FTEs, number of hospital beds, number of patient-admissions, and number of patient-days. To determine potential seroconversions, results of tests (HBsAg, HBeAg, Anti-HCV, Anti-HIV, viral load) performed on the

source-patient and the subsequently exposed worker (HBsAg, Anti-HBs, Anti-HCV, ALT, Anti-HIV) at baseline, and follow-up visits, were examined.

Results

The participating sites comprised eight teaching hospitals and four non-teaching hospitals. Hospital size varied from 106 beds to 2,325 beds. All sites offered adult acute care and some provided pediatric care (nine), long-term care (seven), and community care (three). During the 1-year surveillance period (1 April, 2000 to 31 March, 2001), these 12 sites had a total of 8,534 beds available; 267,416 admissions, 2,355,974 patient-days, and 33,834 FTEs employed in some aspects of patient care or environmental services. Administrative employees were not counted in the number of FTEs since they were not likely to be exposed to blood or body fluid.

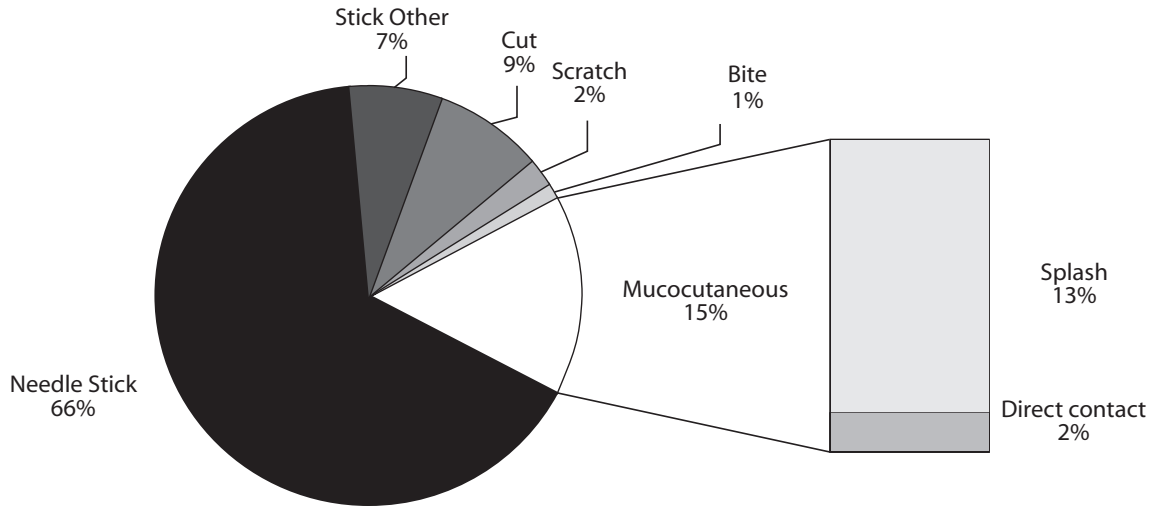
A total of 1,707 exposures to blood and body fluids among HCWs were reported to the CNSSN. Two hundred and seventy-one of these exposures were eliminated from the data presented here because they occurred outside the study period, leaving 1,436 exposures for this analysis.

Exposure incidents

Based on 1,436 reported occupational exposures in the 12 participating sites, the overall rates of injury were 4.24 per 100 FTEs, 16.83 per 100 beds, 0.06 per 100 patient-days, or 0.54 per 100 patient-admissions (Table 1). Considerable variations were observed in the injury rate among facilities, ranging from 1.59 to 12.36 per 100 FTEs and from 2.29 to 31.18 per 100 beds. Rates were markedly higher in teaching hospitals as compared to non-teaching hospitals (4.41 vs 3.45 per 100 FTEs and 21.76 vs 7.03 per 100 beds).

Figure 1 illustrates that 84% of the exposures were percutaneous and 16% were mucocutaneous, with the percutaneous injury rate being higher than the mucocutaneous injury rate (Table 1). Needle stick

Figure 1. Exposure types for all reported exposures – Canadian Needle Stick Surveillance Network, 1 April, 2000 to 31 March, 2001 (n=1,436)



injuries accounted for 78% of the percutaneous exposures, while splashes accounted for 88% of the mucocutaneous exposures. In all exposures (both percutaneous and mucocutaneous) the body fluids most frequently involved in exposures were blood, serum or plasma (85%), followed by saliva stained with blood (4%).

Table 1: Exposure rates based on the number of full-time equivalents (FTEs), hospital beds, patient-days and patient-admissions – Canadian Needle Stick Surveillance Network, 1 April, 2000 to 31 March, 2001

Exposure rates	All exposures (n=1,436)	Percutaneous exposures (n=1,214)	Mucocutaneous exposure (n=222)
Rate per 100 FTEs	4.24	3.59	0.66
Rate per 100 beds	16.13	14.22	2.6
Rate per 100 patient-days	0.06	0.05	0.01
Rate per 100 patient-admissions	0.54	0.45	0.08

Fifty-nine percent of exposures occurred in the following places: operating rooms (19%), medical wards (17%), emergency rooms (9%), surgical wards (7%) or intensive care units (7%). Nearly half of the exposures occurred between 9 AM and 3 PM while 15% occurred between 3 PM and 6 PM. On average, 120 exposures were reported to the CNSSN each month.

Table 2 summarizes the frequency and rates of exposure by job title, with exposure events listed in descending order of frequency. Nurses accounted for 52% of all exposures. However, the nurse's exposure rate per 100 FTEs was only 4.88, a rate much lower than that observed among phlebotomists (42.78), medical residents (20.97), nuclear medical technicians (13.59), sterilization attendants (12.14), or medical specialists (10.06).

Percutaneous exposures

A summary of exposures due to 1,214 percutaneous injuries is presented in Table 3. Sixty-two percent of injuries were caused by five categories of devices that included: (removed all hollow-bore) needles used for drawing arterial/venous blood (14%) or inserting intravenous/arterial lines (7%), needles for percutaneous injection (23%), suture needles (12%), or scapel blades (7%). Three-quarters of the injuries involved broken skin with moderate bleeding, and 5% involved deep cuts with or without bleeding. About 43% of the 1,196 reported injuries occurred during use of the device, 33% after its use (but, before its disposal) and 12% were related to disposal (information was missing and unknown for 12% of the exposures).

Mucocutaneous exposures

A summary of 222 exposures due to mucocutaneous injuries is shown in Table 4. Seventy-one percent of these exposures occurred on mucous membranes. Mucocutaneous exposures were primarily characterized as a splash/projection directly from patients (46%) or leaking/breaking intravenous lines/tubes (24%). The size of the skin surface for mucocutaneous exposures was > 5 cm^2 for seven of the 50 incidents with recorded data. The most common exposure areas for the 156 mucous membrane

Table 2 Annual exposure rates* based on the number of full-time equivalents (FTEs), by job title – Canadian Needle Stick Surveillance Network, 1 April, 2000 to 31 March, 2001

Job title	FTEs	Exposures	Rate per 100 FTEs
Registered nurse†	15,282.87	746	4.88
MD (resident)	515.00	108	20.97
MD (specialist)	824.95	83	10.06
Phlebotomist	172.98	74	42.78
Nursing assistant	2,024.21	67	3.21
Other	5,958.75	68	1.14
Clinical laboratory technician	1,862.46	51	2.74
Sterilization attendant	403.79	49	12.14
Housekeeper	1,247.38	53	4.25
MD (general practitioner)	1,319.80	25	1.89
Other technician	325.38	23	7.09
Nursing student	772.55	18	2.33
Medical student	227.00	15	6.61
Inhalation therapist	309.60	13	4.2
Other attendant	896.30	12	1.34
Nuclear medicine technician	66.22	9	13.59
Radiology technician	576.90	8	1.39
Patient attendant	509.93	8	1.57
Laundry worker	240.86	4	1.66
Unknown	257.57	2	0.77
Dentist	21.20	0	0
Dental hygienist	18.30	0	0
Total	**33,833.90**	**1,436**	**4.24**

* Includes both percutaneous and mucocutaneous exposures.

† Includes 981 days of follow-up among community health nurses = 3.78 FTEs.

exposures were to eyes (62%) or mouths (10%). At the time of exposure, 31% of HCWs were not wearing any protective apparel (among all mucocutaneous exposures), while 65% of HCWs with mucous membrane exposures were not wearing protective eyewear or face shields/surgical masks.

Status of source patient

The source person was identified in 84% of the 1,436 exposures. However, 10% of the 1,203 identified sources were not screened for any bloodborne viruses (15% were not screened for HBV, 10% for HCV and 12% for HIV). Table 5 summarizes the test results among known source patients for these viruses. There were 15 source persons with positive tests for HBV, 77 positive for HCV and 24 positive for HIV. The 116 positive test results were observed among 104 patients; 10 patients were co-infected with two or three viruses (seven with HCV-HIV, one with HBV-HCV and two with HBV-HCV-HIV). The prevalence of bloodborne pathogens among identified, and tested, sources were 1% for HBV, 7% for HCV and 2% for HIV.

Table 3. Summary of exposures due to percutaneous injuries – Canadian Needle Stick Surveillance Network, 1 April, 2000 to 31 March, 2001

	Number	%
Percutaneous injury device and purpose for the use of device		
Needles for blood drawing	174	14
Needles for inserting intravenous/arterial line	87	7
Needles for injecting percutaneously	276	23
Needles used for manipulating an intravenous line	32	3
Lancets or other device for taking sample from finger, heel or ear	35	2
Needles for obtaining tissue or organic fluid except blood	15	1
Suture needles for suturing	140	11
Scapel blades for surgery	80	7
Other surgical instruments (razor, scissors, retractors, metal wire, etc.)	68	6
Glass (vial, tube, pipette, glass object)	24	2
Others (other devices, other/unknown purposes)	264	22
Unknown devices	19	2
Total	1,214	100
Depth of injury		
Superficial (scratch without bleeding)	184	15
Moderate (broken skin with bleeding)	901	74
Deep (stick or deep cut with or without bleeding)	59	5
Missing information	70	6
Total	1,214	100

Further analyses of the 92 source patients infected with HBV or HCV found that nine (10%) had acute hepatitis, 19 were non symptomatic, the status of 33 was unknown and 31 had missing information. Among the 24 source patients infected with HIV, four (17%) had symptoms and six (25%) had full-blown acquired immunodeficiency syndrome (AIDS).

Serologic status of healthcare workers exposed to infected source patient

All 15 HCWs exposed to patients with hepatitis B stated they had been vaccinated against HBV; 10 had proof of vaccination. However, at baseline testing, data revealed that only six were actually immune (i.e., anti-HBs positive) and three were negative for HBsAg.

Table 4. Summary of exposures due to mucocutaneous injuries – Canadian Needle Stick Surveillance Network, 1 April, 2000 to 31 March, 2001

	Number of exposures	%
Nature of exposure		
On mucous membrane	156	70
On non-intact skin	50	23
Missing	12	7
Total	222	100
Size of the skin surface exposed		
< 1 cm^2 (a penny)	23	46
from 1 cm^2 to < 5 cm^2 (a dollar)	4	8
≥ 5 cm^2 ($>$ a dollar)	7	14
Missing	16	32
Total	50	100
Protective clothing/equipment worn by HCWs*		
None	68	31
Gloves	82	37
Eyeglasses (including surgical mask with eyes shields)	35	16
Face shield	4	2
Surgical mask	15	7
Surgical gown	18	8
Cloth laboratory coat	3	1
Plastic apron	4	2
Other/unknown	19	9

* More than one piece of clothing or article may have been worn at the time of exposure.

Table 5. Test results for hepatitis B, hepatitis C, and human immunodeficiency virus (HIV) among known source patients – Canadian Needle Stick Surveillance Network, 1 April, 2000 to 31 March, 2001

Virus	Test	Positive tests (a)	Negative tests (b)	No test result available (c)	% positive (a ÷ a+b)	% of all positive bloodborne virus tests (a ÷ 116)
Hepatitis B	HBsAg	15	1,009	179	1	13
	HBeAg	0	48	1,155	0	
Hepatitis C	Anti-HVC	77	1,001	125	7	66
HIV	Anti-HIV	24*	1,035	144	2	21
	Viral load	4	39	1,160	9	
Any virus		116†	3,132	2,763	4	100

* The four positive viral load were: 779; 2,900; 11,400 and 16,100 virus copies/mL.

† The 116 positive tests occurred in only 104 individuals; seven source individuals tested positive for HCV-HIV, one tested positive for HBV-HCV, and two tested positive for HBV-HCV-HIV.

Among 77 HCWs exposed to patients with HCV, the follow-up rate was 84% at baseline, 31% presented for follow-up 3 months later, and only 12% presented for follow-up after 6 months. One HCW was anti-HCV positive at baseline (i.e., infected prior to exposure). Among 24 HCWs exposed to patients with HIV, the follow-up rates for anti-HIV was 75% at baseline, 54% presented for follow-up 6 weeks later and 33% presented for follow-up at 3 months.

To date, no HCW exposed to HIV, HBV or HCV have become infected with HIV, HBV or HCV as a result of the exposure.

Discussion

The CNSSN data are pooled from 12 sites networking with Health Canada to report occupational exposures to blood and body fluids; therefore, site self-selection and reporting biases inherent to a voluntary registry limit the interpretation. Although the data are not representative of all hospitals across Canada, some observations can be drawn from the findings:

HCWs in selected sites face the risk of being exposed to and acquiring bloodborne pathogens. HCWs at particular risk include those working in teaching hospitals, those working as phlebotomists, medical residents, nuclear medical technicians and sterilization attendants. The study identifies nurses as the group most frequently reporting exposures; an observation commonly reported in studies done in Canada[1-3]. However, when the frequencies of exposure by the rate per 100 FTEs were adjusted, a lower rate was found among nurses than among phlebotomists, medical residents, nuclear medical technicians and sterilization attendants. The finding suggests a disproportionate risk of being exposed among personnel engaged in blood-drawing and sterilization procedures.

According to a case-control study done by the Centers for Disease Control and Prevention[4], deep injury (causing bleeding) from a hollow-bore, blood-filled needle and visible contamination of the device with patient's blood carry the greatest risk injuries. Procedures that involve a large-gauge hollow-bore needle inserted directly in an artery or vein have a higher risk of HIV transmission to the HCW than procedures involving a solid needle (e.g., suture) or a small-gauge hollow-bore needle (e.g., needle for intramuscular or subcutaneous injection) or injection into an intravenous catheter[4-5]. The rate of percutaneous injuries caused by needle sticks focuses the need to tailor sharp/needle stick prevention programs or preventing injuries that involve hollow-bore needles inserted into blood vessels.

Forty-five percent of percutaneous injuries may have been prevented by proper handling and disposal of used needles. The application of recommended control measures such as engineering controls (safety devices, sharp disposal containers), administrative controls (timely and effective post-exposure protocol) and work-practice controls (immunization, hands-free technique in the operating room, universal precautions) may decrease the number of significant exposures. Two thirds of mucous-membrane exposures may have been prevented by use of protective eyewear or face shields.

The prevalence of HCV and HIV among identified sources along with the proportion of infected sources who have symptoms (acute hepatitis, full-blown AIDS) or co-infections (HCV-HBV, HIV-HCV, HBV-HCV-HIV) are worrisome. These situations are more likely to put HCWs at risk of acquiring the bloodborne infections, as well as complicate further the post-exposure management of HCWs exposed to infected sources.

Continued needlestick injury surveillance among HCWs to track the transmission patterns and to monitor the post-exposure management of HCWs exposed to bloodborne pathogen positive sources will enable targeted prevention strategies to reduce the incidence of HCWs acquiring a bloodborne pathogen.

Note

The Bloodborne Pathogens/Nosocomial and Occupational Infections Division plans to expand the surveillance network to more sites. All hospitals interested in collecting this data should contact Mai Nguyen for further information, telephone: (613) 946-0169.

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– Glossary –

Additional Precautions

Interventions implemented for certain pathogens or clinical presentations in addition to routine infection control practices, to reduce the risk of transmission of microorganisms from patient to patient, patient to HCW, and HCW to patient[4].

Antiseptic

A product with antimicrobial activity that is designed for use on skin or other superficial tissues and removes both transient and resident flora. The term is used for preparations applied to living tissues[4].

Colonization

The presence of microorganisms in or on a host with growth and multiplication but without tissue invasion or cellular injury[4].

Communicable

Capable of being transmitted from one person to another; synonymous with "infectious" and "contagious"[4].

Disease

Clinical expression of infection; signs and/or symptoms are produced[4].

Emergency responders

Ambulance, fire, police and paramedic workers[19,96-99,114].

Exclude from work (unfit for work)

Defined as "restrict from patient care tasks, coworker contact and restriction from the workplace".

Exposure

The condition of being subjected to a microorganism or an infectious disease in a manner that enables transmission to occur.

Exposure-prone procedures

Procedures during which transmission of HBV, HCV, or HIV from a HCW to patients is most likely to occur, which includes the following:

a) digital palpation of a needle tip in a body cavity (a hollow space within the body or one of its organs) or the simultaneous presence of the HCW's fingers and a needle or other sharp instrument or object in a blind or highly confined anatomic site, e.g. during major abdominal, cardiothoracic, vaginal and/or orthopedic operations, or

b) repair of major traumatic injuries, or

c) major cutting or removal of any oral or perioral tissue, including tooth structures, during which there is a potential for the patient's open tissues to be exposed to the blood of an injured HCW[9].

It is not the intent to include all invasive dental procedures as exposure-prone, although this is theoretically possible; rather, the goal is to identify those procedures involving a major opening in the oral or perioral tissue.

Fit for work

Terminology used in occupational health to communicate a worker's ability to remain at or return to work. The phrase is one of three qualifiers: fit for work, unfit for work, fit with restrictions. It allows the occupational health nurse to maintain confidentiality about a HCW's diagnosis, symptoms, immune status, etc.

Fit with restrictions

Allows for reassignment of duties or reintegration into the workplace in a manner that will not pose an infection risk to the HCW or to the individuals in the workplace.

Health care workplace

The hospital, building, agency, or area, e.g. ambulance, where health care is provided.

Health care worker (HCW)

An individual who may have the potential to acquire or transmit an infectious agent during the course of his or her work in the health care workplace, e.g. nurses, residents, physicians, researchers, volunteers, and emergency responders.

Immune status

A history of disease, immunization or laboratory confirmation of immunity.

Immunocompromised

Increased susceptibility to infection. In this document the term refers to patients with congenital or acquired immunodeficiency due to chemotherapeutic agents or hematologic malignancies[4].

Infection

The entry and multiplication of an infectious agent in the tissues of the host.

a) inapparent (asymptomatic, subclinical) infection: an infectious process running a course similar to that of clinical disease but below the threshold of clinical symptoms

b) apparent (symptomatic, clinical) infection: one resulting in clinical signs and symptoms (disease)[4].

Infectious

Caused by infection or capable of being transmitted[4].

Nosocomial

Infection acquired by a patient in a health care setting.

Outbreak

An excess over the expected incidence of disease within a geographic area during a specified time period, synonymous with epidemic[4].

Routine practices

Infection control practices used in the care of all patients to reduce the risk of transmission of microorganisms from patient to patient; patient to HCW, and HCW to patient[4].

Safer engineered devices

A device designed to reduce the incidence of needlestick injuries and potential exposure of HCWs to bloodborne pathogens.

a) an “active” safety device, e.g. syringe with needle guard, requiring that the operator actively engage the safety feature to ensure its proper function whereas

b) a “passive” safety device, e.g. recessed or protected needle, is one that requires no action on the part of a HCW to ensure protection and is usually in effect throughout the use of the device[38].

Sharps injuries

Injuries caused by percutaneous injuries or cuts.

Source

The person, animal, object, or substance from which an infectious agent passes to a host[23].

Susceptible

An individual not possessing sufficient resistance against a particular pathogenic agent to prevent contracting infection or disease when exposed to the agent[23]; synonymous with non-immune.

Symptomatic

Presenting symptoms compatible with an infectious process before a definitive diagnosis is made. See also infection.

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