INSPQ
INSTITUT NATIONAL
DE SANTÉ PUBLIQUE
DU QUÉBEC

Infection Prevention and Control Measures in the Emergency Department

Québec

Infection Prevention and Control Measures in the Emergency Department

SCIENTIFIC ADVISORY

Direction des risques biologiques et de la santé au travail

September 2013

Institut national de santé publique Québec

AUTHOR

Comité sur les infections nosocomiales du Québec (CINQ)

EDITORS

Anne-Marie Lowe, Institut national de santé publique du Québec

Patrick Dolcé, Centre de santé et de services sociaux de Rimouski-Neigette

WORKING GROUP

Bruno Baril, Association des médecins d'urgence du Québec

Patrick Dolcé, Centre de santé et de services sociaux de Rimouski-Neigette

Danielle Goulet, Centre hospitalier universitaire de Québec

Lise Langevin, Direction nationale des urgences, Ministère de la Santé et des Services sociaux

Anne-Marie Lowe, Institut national de santé publique du Québec

Carine Sauvé, Association des infirmières et infirmiers d'urgence du Québec

Denise Trudel, Direction nationale des urgences, Ministère de la Santé et des Services sociaux

IN COLLABORATION WITH

Marie Gourdeau, Centre hospitalier affilié de Québec, Pavillon Hôpital de l'Enfant-Jésus

Luc Larue, Association des gestionnaires infirmiers d'urgence du Québec

Louis Leduc, Ordre des architectes du Québec

Caroline Quach, McGill University Health Centre, Montreal Children's Hospital

Marcel Rheault, Association des gestionnaires infirmiers d'urgence du Québec

TECHNICAL SUPPORT

Mélissa Trudeau, Institut national de santé publique du Québec

LAYOUT

Murielle St-Onge, Institut national de santé publique du Québec

TRANSLATION

Translation: Barbara Pattison, C.tr.

The translation of this publication was made possible with funding from the Public Health Agency of Canada.

LEGAL DEPOSIT – 1st QUARTER 2015
BIBLIOTHÈQUE ET ARCHIVES NATIONALES DU QUÉBEC
LIBRARY AND ARCHIVES CANADA
ISBN: 978-2-550-69536-3 (FRENCH PDF)
ISBN: 978-2-550-72695-1 (PDF)

List of members of the Comité sur les infections nosocomiales du Québec (CINQ) [Québec healthcare-associated infections committee]

Active Members[1]

Lise-Andrée Galarneau, Committee Chair, Centre hospitalier régional de Trois-Rivières

Lucie Beaudreau, Institut national de santé publique du Québec

Michèle Dupont, Agence de la santé et des services sociaux de Montréal, Institut national de santé publique du Québec

Charles Frenette, McGill University Health Centre

Christophe Garenc, Institut national de santé publique du Québec

Danielle Goulet, Centre hospitalier universitaire de Québec

Marie Gourdeau, Centre hospitalier affilié universitaire de Québec, Pavillon Hôpital de l'Enfant-Jésus

Yves Longtin, Jewish General Hospital, Montréal

Josée Massicotte, Agence de la santé et des services sociaux de la Montérégie, Direction de santé publique de la Montérégie

Danielle Moisan, Centre de santé et de services sociaux de Rivière-du-Loup

Renée Paré, Agence de la santé et des services sociaux de Montréal, Direction de santé publique de Montréal

Isabelle Rocher, Institut national de santé publique du Québec

Pierre St-Antoine, Centre hospitalier de l'Université de Montréal, Pavillon Notre-Dame

Claude Tremblay, Centre hospitalier universitaire de Québec, Pavillon Hôtel-Dieu de Québec

Jasmin Villeneuve, Agence de la santé et des services sociaux de la Capitale-Nationale, Direction régionale de santé publique de la Capitale-Nationale

Ex-officio Members

Marc Dionne, Institut national de santé publique du Québec

Cécile Tremblay, Laboratoire de santé publique du Québec (or representative: Simon Lévesque)

Liaison Members

Roger Savard, Centre de santé et de services sociaux de Chicoutimi

Danielle Auger[2], Ministère de la Santé et des Services sociaux du Québec (or representative: Madeleine Tremblay)

1 At the time of approval of the recommendations (June 14, 2012), Constance Forget-Falcicchio, from the Jewish Rehabilitation Hospital (Laval), was an active member of the CINQ.

2 At the time of approval of the recommendations (June 14, 2012), the Director of Public Health at the Ministère de la Santé et des Services sociaux du Québec was Horacio Arruda.

Summary

Every year, over 3 million patients, including many cases of transmissible infections, arrive at Québec's emergency departments on foot or by ambulance. In Québec, reference documents are available on emergency department organization and design(1-3). However, at present, there are few recommendations for infection prevention and control (IPC) in the literature that focus on practice in an emergency care setting.

This document has been prepared in connection with Action 8 of the Ministère de la Santé et des Services sociaux' (MSSS) *Plan d'action sur la prévention et le contrôle des infections nosocomiales 2010-2015* [2010-2015 Action plan for healthcare-associated infections prevention and control](4). Its purpose is to make recommendations for IPC in the emergency departments of Québec's hospitals.

The recommendations are primarily intended for general and specialized hospital centres. They will have to be adapted according to the facility's mission, the patient population served and various local epidemiological factors.

The recommendations in the document are categorized under the different areas of the emergency department (Appendix 1) and integrate Health Canada's three-tier hierarchy of IPC controls: engineering controls, administrative controls, and personal protective equipment (Appendix 2)(5-7). Engineering control recommendations should be given priority when constructing new emergency departments or renovating existing emergency departments. An action plan should be developed to ensure these recommendations are integrated into future work.

Recommendations

GENERAL MEASURES TO BE APPLIED THROUGHOUT THE EMERGENCY DEPARTMENT

Engineering Controls

1 Install a ventilation system, accompanied by a quality assurance program that complies with current norms and standards and takes into account the specific requirements of the different areas in the emergency department, including the ambulance garage. **(1A)**

2 Install a room temperature and relative humidity control system in accordance with current standards. **(1A)**

3 Install a ventilation system and organize the physical environment so that air pressure in the emergency department is negative relative to adjacent areas. **(1A)**

4 Provide at least one airborne infection isolation room (negative pressure isolation room), with a toilet and sink (in addition to the one in the trauma and resuscitation area). **(1A)**

5 Provide an adequate number of airborne infection isolation rooms relative to the number of regular beds in the emergency department, based on the organizational risk assessment, the organization's mission and the level of care provided. **(1C)**

6 When constructing a new emergency department or redesigning an existing emergency department, the airborne infection isolation room should be situated in such a way that the patient occupying the room does not circulate among beds or in other areas where many people are gathered. **(1B)**

7 Provide protective environment rooms (positive pressure isolation rooms), with a toilet and sink, based on the organization's needs and mission and patient characteristics. **(1A)**

8 Ensure that a monitoring system with an alarm is installed in airborne infection isolation rooms and protective environment rooms, where applicable, to signal any malfunction of the ventilation system that would lead to a reduction in the pressure differential. **(1A)**

9 Use surface materials that are easy to clean and resistant to the detergents and disinfectants used. **(1A)**

10 Ensure there is sufficient space to install IPC equipment for patients and staff (e.g., ABHR dispensers, disinfectant wipes, masks, gowns, gloves, tissues, no-touch waste receptacles). **(1A)**

11 Apply the same IPC standards to overflow beds and regular beds. **(1A)**

12 Provide spaces in each area and near each bed to post information about IPC (e.g., isolation, hand hygiene, respiratory hygiene and cough etiquette). **(1A)**

13 Provide entrances reserved solely for the emergency department so that the entrance is not used to access other areas in the hospital and restrict traffic at all times (day, evening, night). **(1A)**

14 Take measures to prevent the intrusion of insects and other pests via the entrance to the ambulance garage, windows and doors (e.g., install mosquito screens on windows, keep doors closed). **(1B)**

15 Provide physically separate clean and soiled utility rooms. **(1A)**

16 Provide a decontamination area, ideally a closed room, adjacent to the emergency department garage to receive people who have been in contact with hazardous materials. **(1A)**

Administrative Controls

17 Ensure management and administrators support the application of IPC measures in the emergency department. **(1A)**

18 Ensure routine practices and additional precautions are implemented when indicated and provide training and documentation on these measures. **(1A)**

19 Ensure staff, patients and visitors comply with hand hygiene. **(1A)**

20 Ensure patients, visitors and staff observe respiratory hygiene and cough etiquette. **(1A)**

21 Ensure the necessary equipment is available for the implementation of routine practices, respiratory hygiene / cough etiquette and additional precautions. **(1A)**

22 Provide ABHR dispensers at all points of care, in all strategic areas and in designated staff areas and ensure they are kept filled. **(1A)**

23 Hold continuing education activities in IPC for emergency department staff (health care and support teams). **(1A)**

24 Develop and implement an active surveillance system for infectious diseases of epidemiological significance (e.g., influenza-like illness [influenza, SARS, SRI], febrile rash illness [measles], infectious gastroenteritis, other outbreaks of diseases in the community of interest to public health). **(1B)**

25 Participate in mandatory public health surveillance programs (e.g., notifiable diseases, SRI, influenza). **(1B)**

26 Participate in local healthcare-associated infections surveillance programs by notifying the IPC team when patients present to the emergency department with healthcare-associated infections such as surgical site infections, gastroenteritis, urinary tract infections, etc. **(1B)**

27 Monitor IPC procedures in the emergency department (e.g., audit adherence to routine practices, additional precautions and cleaning and disinfection protocols). **(1B)**

28 Ensure surveillance results are interpreted and distributed to staff and administrators. **(1B)**

29 Establish an IPC subcommittee in the emergency department. **(2)**

30 Apply measures to limit overflow in the emergency department bed area. Do not board admitted patients in emergency department beds. **(1A)**

31 Develop a contingency plan for epidemics, pandemics and bioterrorism. **(1A)**

32 When renovating or constructing an emergency department, involve the IPC team in the project at the planning and design stage. **(1A)**

33 Communicate the relevant information regarding any patient with a clinical picture of a transmissible infection to any other departments concerned (e.g., additional precautions to be applied). **(1C)**

34 Ensure that medical and nursing staff in the emergency department are informed in real time about outbreaks of infectious diseases in their community. **(1A)**

35 Use information technology to provide rapid access to data on a patient's infectious status (e.g., MRSA or VRE carrier) and to effectively communicate information of interest to public health (e.g., outbreak of an infectious disease in the community for a given region or country). **(1B)**

36 Health care staff who have symptoms of a transmissible infection should stay at home until the period of contagiousness is over; in exceptional cases, if there is an impact on care and services (e.g., disruption of services), provide for a procedure that allows sick staff to be assigned to support activities. **(1C)**

37 Implement an immunization program for staff in the process of being hired and those already employed based on the risks associated with their work. **(1A)**

38 Ensure that cleaning and disinfection guidelines are followed at all times (24/24, 7/7). **(1C)**

39 Develop and apply cleaning and disinfection protocols for environmental surfaces and patient care equipment. **(1B)**

40 Adjust cleaning and disinfection protocols depending on:

- the pathogens and clinical syndromes involved; **(1B)**
- the frequency of contact (high touch and low touch); **(1C)**
- the volume of use and current epidemiology. **(1B)**

41 Work toward eliminating grey areas in the emergency department. Clearly define responsibility for the maintenance of all equipment. **(1C)**

42 Use a log to record the cleaning and disinfection procedures performed for equipment and areas. **(1C)**

43 Disinfect objects used for more than one patient (e.g., stethoscopes, scissors, blood pressure equipment) between each use. **(1A)**

44 Establish a quality assurance program to ensure the routine maintenance of ventilation systems and appropriate ventilation parameters at all times. **(1C)**

45 Make puncture-resistant containers available and accessible at all points of care for sharps disposal and ensure they are replaced once filled to their safe maximum capacity. **(1A)**

46 At a minimum, provide containers for waste and soiled material at all points of care. **(1B)**

47 Develop and apply a protocol for safe human waste and body fluids management. **(1C)**

Personal Protective Equipment

48 Use personal protective equipment (e.g., gloves, mask, eye protection, gown) in accordance with routine practices and additional precautions. **(1A)**

SPECIFIC MEASURES TO BE APPLIED IN THE REGISTRATION, RAPID ASSESSMENT AND TRIAGE AREA (ARRIVAL ON FOOT OR BY AMBULANCE)

Engineering Controls

49 Provide a physical barrier in the registration area between patients and staff. **(1B)**

50 Provide triage rooms with negative pressure ventilation. **(1A)**

Administrative Controls

51 Implement a pre-triage system during busy times or a community outbreak. **(1B)**

52 Establish a system to rapidly direct patients to the appropriate area of the emergency department based on their presumed infectious status (e.g., airborne infection isolation room, designated waiting room, etc.). If an airborne infection is suspected (e.g., tuberculosis, chickenpox, measles, SRI), promptly direct the patient to an airborne infection isolation room in the emergency department or to a unit where this type of room is available. **(1A)**

53 Upon arrival, immediately assess patients for fever, cough, skin rash, diarrhea, vomiting or any other symptoms that suggest a clinical picture of infection in order to promptly implement appropriate additional precautions. If a patient has these symptoms, immediately collect further information, such as history of travel and infectious contact. **(1A)**

Arrival by Ambulance

54 If a patient with a clinical picture of a transmissible infection arrives by ambulance, ensure that ambulance workers give the information to emergency department staff so that IPC measures are implemented immediately. **(1B)**

SPECIFIC MEASURES TO BE APPLIED IN THE WAITING ROOM

Engineering Controls

55 Provide a separate waiting room for cohorting of patients with a clinical picture of a transmissible respiratory infection. **(1A)**

56 If there is no designated waiting room, designate a separate area in the main waiting room, separated by a physical barrier, for cohorting of patients with a similar clinical picture of transmissible infection and limit contact between patients. **(1B)**

57 Provide ABHR dispensers, masks and tissues as well as no-touch waste receptacles in the common waiting room and in the designated room for respiratory hygiene / cough etiquette. **(1B)**

58 Provide an adequate number of toilets for all patients in the waiting room, including the designated waiting room, taking capacity and volume of users into account. **(2)**

Administrative Controls

59 Group patients with similar clinical syndromes together in the waiting room or in a designated area of the waiting room. **(1C)**

60 If the waiting room is not separated by a physical barrier, a distance of two metres should be maintained between patients with a clinical picture of a transmissible respiratory infection and other patients in the common waiting room. **(1C)**

61 Provide a designated toilet for patients with a clinical picture of infectious gastroenteritis during a community outbreak and increase the frequency of cleaning and disinfection. **(1B)**

62 Disseminate educational messages on IPC (e.g., respiratory hygiene / cough etiquette, hand hygiene). **(2)**

63 Do not permit toys in the waiting room. **(1B)**

64 Do not permit books and magazines in the waiting room. **(2)**

SPECIFIC MEASURES TO BE APPLIED IN THE AMBULATORY AREA AND EXAMINATION AND TREATMENT ROOMS

Engineering Controls

65 Provide an adequate number of toilet rooms near examination and treatment rooms. **(2)**

66 Provide an adequate number of clothes hooks in each examination and treatment room. **(1C)**

67 Store equipment in examination and treatment rooms in closed cupboards or drawers to reduce the risk of contamination. **(1B)**

Administrative Controls

68 Cleaning and disinfection must always be performed rapidly following discharge of a patient known to be a carrier of a transmissible pathogen (e.g., MRSA, VRE, *C. difficile*, norovirus, influenza, etc.) or who has a similar clinical syndrome. **(1B)**

69 Cover the examination table with clean paper or a clean sheet for each patient and clean surfaces that have been in contact with the patient immediately after they leave. Ensure the table is routinely cleaned on a daily basis and adjust the frequency of cleaning depending on frequency of use and type of treatment. **(1B)**

SPECIFIC MEASURES TO BE APPLIED IN THE EMERGENCY DEPARTMENT BED AREA

Engineering Controls

70 For new constructions and for renovations to an existing emergency department, the target should be 100% single rooms that can be closed by a glass door. **(1B)**

71 Do not use curtains to separate beds; instead use rigid, fixed, easily cleaned partitions. **(1B)**

72 A ratio of 50 to 100% of closed rooms should have a private toilet with a sink. **(1C)**

73 For emergency departments with beds without a private toilet, provide a minimum ratio of one toilet with a sink for every five beds. **(1C)**

74 Provide an adequate number of sinks in the ED bed area and in designated staff areas. **(1A)**

75 Provide ABHR dispensers at the point of care for each bed, including overflow beds. **(1A)**

76 Allow a distance of one and a half to two metres between beds that are not in closed rooms (e.g., overflow beds in the corridor). **(1B)**

77 Provide an adequate number of clothes hooks outside each bed space. **(1C)**

78 Ensure there is sufficient space near the point of care of each bed space to install mobile units that contain dedicated equipment and PPE. **(1B)**

79 Provide storage spaces for mobile units that contain dedicated equipment and PPE. **(1B)**

80 Ensure there is sufficient space in each bed space to install receptacles that are large enough for the disposal of soiled PPE. **(1B)**

SPECIFIC MEASURES TO BE APPLIED IN THE TRAUMA AND RESUSCITATION AREA

Engineering Controls

81 Provide a bed in an airborne infection isolation room in the trauma and resuscitation area that can be used for patients with a clinical picture of a transmissible respiratory infection. **(1A)**

82 Provide positive pressure ventilation in trauma and resuscitation rooms that are primarily used for surgery. **(1A)**

83 Do not use curtains to separate trauma and resuscitation beds. **(1B)**

84 Keep only the necessary amount of equipment in the trauma and resuscitation room and store extra supplies in closed cupboards to reduce the risk of contamination. **(1B)**

Administrative Controls

85 Implement the necessary best practices to prevent healthcare-associated infections when performing invasive procedures. **(1B)**

Table of contents

List of tables

List of figures

List of initialisms and acronyms

ABHR	Alcohol-based hand rub
AETMIS	Agence d'évaluation des technologies et modes d'intervention en santé [Agency for health services and technology assessment]
AIA	American Institute of Architecture
APIC	Association for Professionals in Infection Control and Epidemiology
CDC	Centers for Disease Control and Prevention
CHSLD	Centre d'hébergement et de soins de longue durée [Residential and long-term care facility]
CINQ	Comité sur les infections nosocomiales du Québec [Québec healthcare-associated infections committee]
CPSI	Canadian Patient Safety Institute
CSA	Canadian Standards Association
CTAS	Canadian Triage and Acuity Scale
FGI	Facility Guidelines Institute
HIV	Human immunodeficiency virus
HVAC	Heating, ventilation and air conditioning
INSPQ	Institut national de santé publique du Québec [Québec national institute of public health]
IPC	Infection prevention and control
MRSA	Methicillin-resistant *Staphylococcus aureus*
MSSS	Ministère de la Santé et des Services sociaux [Ministry of health and social services]
OR	Odds ratio
PHAC	Public Health Agency of Canada
PPE	Personal protective equipment
RNA	Ribonucleic acid
RSV	Respiratory syncytial virus
SARS	Severe acute respiratory syndrome
SRI	Severe respiratory illness

VAP	Ventilator-associated pneumonia
VRE	Vancomycin-resistant enterococci
WHO	World Health Organization

Glossary

The following definitions were taken from or are based on documents available on the Internet(8-11).

Additional precautions: Prevention measures used for people with a transmissible infection or who are colonized with a multi-resistant germ for which routine practices are insufficient to prevent transmission. Additional precautions must be taken to protect other individuals from acquiring certain potentially pathogenic microorganisms and reduce their transmission. These precautions are based on the mode of transmission (contact, droplet, airborne).

Aerosol: Small droplets of moisture that can carry microorganisms. They are light enough to remain suspended in the air for short periods, allowing microorganisms to be inhaled.

Airborne infection isolation room (AIIR): Room in which the air pressure is lower than in adjacent rooms and complies with a standard for the number of air changes per hour. This promotes inward airflow and the dilution of suspended, potentially infectious particles. Also called a negative pressure room.

Airborne precautions: Prevention measures used for people with or suspected of having an airborne disease. Airborne precautions are used in addition to routine practices. This mode of transmission concerns infections that are spread by aerosols that remain suspended in the air for long periods, retain their infectious potential and may be deposited in the lower respiratory tract. These infections can be transmitted over long distances.

Alcohol-based hand rub: Alcohol-based hand rubs are alcohol-containing preparations designed for application to the hands to inactivate and inhibit the growth of microorganisms. They come in different forms (liquid, gel, foam) and can contain one or more types of alcohol.

Cleaning: Operation to remove dirt, dust and other substances that can harbour microorganisms. The objective of cleaning is cleanliness.

Contact precautions: Additional precautions taken to reduce the risk of transmission of infectious agents by contact with an infected or colonized person or his[3] potentially contaminated environment. Contact precautions are used in addition to routine practices.

Disinfection: Process that inactivates most pathogens on an object or surface. Disinfection does not destroy bacterial spores. The object or surface must be cleaned prior to disinfection.

Droplet precautions: Additional precautions taken to reduce the risk of transmission of infectious agents by droplets generated by an infected or colonized person. Droplet precautions are used in addition to routine practices for patients with an infection that can be transmitted by infectious droplets that are too large to be deposited in the lower respiratory tract.

Emergency department: The term "emergency department" refers to the physical location.

[3] In this document, the masculine gender designates both sexes and is used solely to facilitate reading.

Environment: The environment includes the various surfaces of floors, walls, fixed and mobile equipment, furniture and fixtures that may have direct or indirect contact with patients. The environment can therefore be a reservoir for pathogens that can be transmitted to patients, visitors and staff.

Grey areas in housekeeping: Surfaces for which responsibility for cleaning and disinfection has not been assigned to a department (for example, small devices and fixtures used in health care facilities).

Health care team: Refers to all personswho provide care to a patient (physicians, nurses, respiratory therapists, etc.).

HEPA filter: Filter installed in a ventilation system with 99.97% efficiency for removing airborne particles greater than 0.3 microns in diameter.

Patient: The term "patient" is used in this document. It can refer to a person who undergoes a medical examination, receives treatment or undergoes surgery as well as to pregnant women.

Point of care: Place where a patient receives health care or the health care site itself.

Pre-triage: Step that is sometimes added to the patient pathway on arrival at the emergency department during infectious disease outbreaks, epidemics, pandemics or when required by the situation.

Protective environment room**:** Room in which the air pressure is higher than in adjacent rooms, promoting outward airflow. A HEPA air intake filtration system should be installed in some of these rooms. Also called positive pressure room.

Rapid assessment: This step is completed prior to triage and is sometimes called "rapid triage".

Risk assessment: Assessment of interactions between health care staff, the patient and the patient environment to determine the risk of transmission of an infectious disease.

Routine practices: Routine practices are a set of infection prevention and control measures. These measures must be applied to prevent and reduce the risk of transmission of pathogenic microorganisms from blood, body fluids, secretions and excretions (except sweat), non-intact skin and mucous membranes. These practices must be incorporated into the routine care of all patients in health care settings, at all times and in all departments, including the emergency department.

Triage: Sometimes called "complete assessment", triage is the process of rapidly assessing patients when they arrive at the emergency department in order to prioritize patient care requirements.

1 Methodology

Procedure Followed to Develop the IPC Recommendations

A working group composed of professionals from the field of IPC, emergency services, public health, nursing and architecture began its work in April 2010 in order to propose tools and procedures for IPC, specifically for emergency departments. The objectives were to conduct a literature review, develop a framework, design and conduct a survey to collect data on the current situation in Québec's emergency departments, produce a scientific advisory and add collaborators to the working group for consultation and comments. The working group held many meetings during which scientific evidence from the literature review was discussed and evaluated. These discussions led to the measures recommended in this document. They were approved by the CINQ in June 2012.

Literature Search

A literature search was done in the specialized PubMed database and on the Web sites of IPC and emergency medicine organizations. The keywords used for the search were "emergency", "room", "department", "nosocomial", "infection", "control", "architecture", "design", "healthcare-associated infections", "patient safety indicators". Articles in English and French from 2000 to 2010 were identified and only those whose title matched the subject of interest were selected. If the abstract was relevant, the full article was obtained. The bibliographies of various documents were also searched. An ongoing scientific watch on the topics "emergency nosocomial infection", "infection control emergency department", "nosocomial emergency department design", "nosocomial infection architecture" was initiated in 2010.

Study on Infection Prevention and Control in Québec's Emergency Departments

Using the SurveyMonkey tool, an electronic questionnaire was created on the topic of emergency department design (single rooms, airborne infection isolation rooms, toilets, waiting rooms), hand hygiene measures (presence of sinks, alcohol-based hand rub dispensers, audits of compliance with certain IPC practices), housekeeping, as well as IPC and surveillance measures in the emergency department.

In September 2010, the questionnaire was sent to IPC professionals in general and specialized hospital centres with an emergency department and more than 1000 admissions per year. The collaboration of emergency department professionals was recommended. Two email reminders were sent and the data collection was completed in October 2010. The data was analysed using Microsoft Excel 2007, Epi Info and SPSS Statistics 17.0.

Rating Categories for Recommendations

Each recommendation was rated using the rating system shown in Appendix 3. The quality of all the information available to support each of the recommendations was evaluated by the working group. Each rating was therefore assigned by consensus. It is important to note that few high-quality studies (e.g., randomized controlled studies) have been conducted in the field of IPC. However, certain practices based on evidence and theoretical rationales are widely accepted and their application is recommended internationally (e.g., aseptic technique). Other IPC measures may be the result of government directives.

2 Introduction

Healthcare-Associated Infections

Healthcare-associated infections are infections acquired during the course of medical treatment in a health care facility, irrespective of the setting(12). These infections are not present or incubating at the time of patient admission(13). They are a substantial burden for health systems, both in Québec and in other parts of the world. The repercussions are significant, not only for the patient and his family, but also for the health care facility and society(4). Healthcare-associated infections add to the functional disability and emotional stress of patients and may, in some cases, lead to disabling conditions that reduce the quality of life. The World Health Organization (WHO) estimates that 5 to 10% of patients admitted to hospital will develop a nosocomial infection, with a mortality rate of around 4%(13).

Healthcare-associated infections are one of the leading causes of death and the economic costs are considerable. The increased length of stay for infected patients is the greatest contributor to cost(13). The average cost of a nosocomial infection (prolonged stay, additional care) has been estimated at $29,000 for a central line-associated bloodstream infection, $7,000 for methicillin-resistant *Staphylococcus aureus* (MRSA) colonization, $33,000 for a case of vancomycin-resistant enterococci (VRE) and $15,000 for *Clostridium difficile.* The estimated costs of a gastroenteritis outbreak (norovirus, rotavirus) are $650,000. Hospital-acquired respiratory viruses (respiratory syncytial virus [RSV], influenza) generate additional costs of $3,860 per infection(14).

The MSSS's *Plan d'action sur la prévention et le contrôle des infections nosocomiales 2010-2015* points out that prolonged stays and additional care due to healthcare-associated infections costs Québec roughly 180 million dollars annually. A 30% reduction in healthcare-associated infections would therefore generate annual savings of over 40 million dollars for Québec's health care network and free up the equivalent of 360 beds annually. This would relieve emergency department congestion, help reduce waiting lists and increase efficiency in facilities(4).

The Risk of Transmission of Infections in the Emergency Department

The emergency department is one of the main gateways to Québec's hospital network. Infections are the reason for a significant proportion of visits to the emergency department, particularly in the pediatric population(15). Patients may carry various transmissible pathogenic microorganisms such as the influenza virus, norovirus, rotavirus, etc.(16-27). Some individuals may also be carriers of antibiotic-resistant microorganisms such as MRSA or VRE(28-33), blood-borne viruses such as human immunodeficiency virus (HIV)(34-36), or airborne diseases such as tuberculosis(37,38). The emergency department may also see patients with emerging or bioterrorism-related infectious diseases, for example, severe acute respiratory syndrome (SARS), the plague, anthrax, avian influenza A(H5N1), measles(17, 18, 39-46).

The SARS outbreak in Toronto in 2003 showed a high transmission rate for this pathogen in emergency departments, highlighting a number of deficiencies in existing practices and infrastructure(17, 18, 41). Furthermore, the lessons learned as a result of the influenza A(H1N1) pandemic showed that hospital emergency departments are strategic places for managing this type of crisis(47).

Many factors contribute to the risk of transmission of infections for staff and patients in the emergency department, in particular the high proportion of vulnerable patients, such as immunocompromised patients and elderly persons. Quach et al. reported that in the absence of

outbreaks of respiratory and gastrointestinal infections in long-term care facilities, the risk of these residents developing symptoms of respiratory tract infections or gastroenteritis was 3.9 times higher in the week following a visit to the emergency department compared with residents who did not leave the facility(48). Hospital overcrowding, delays in implementing additional precautions, cohorting and crowding patients together with transmissible infections, movement and transfer of patients from one area to another in the emergency department, deficiencies in building design and infrastructure, inadequate staff training and shortages of personal protective equipment also contribute to the risk of transmission of infections(28-30, 47, 49-52, 52-56).

Application of the Hierarchy of Controls to Minimize the Risk of Transmission of Infections in the Emergency Department

Collaboration between IPC professionals, occupational health professionals and health care organization personnel has led to a better understanding and application of a tiered framework of measures and interventions that allows health care organizations to comprehensively evaluate the risk of exposure to infectious agents in the workplace and the effectiveness of their mitigation responses(7). The implementation of a hierarchy of controls was effective in controlling the transmission of tuberculosis in health care settings in the 1990s and in 2003, and the transmission of SARS in Asia, Canada and the United States in 2003(57-59).

Emergency departments must be prepared to deal with the resurgence of known microorganisms or the emergence of new pathogens. The implementation of IPC measures using the hierarchy of controls approach (engineering controls, administrative controls and the use of personal protective equipment) has proven to be very effective(58).

IPC Measures in Québec's Emergency Departments: Recommendations and Scientific Evidence

The purpose of this document is to make recommendations for IPC in the emergency departments of Québec's hospitals. They were developed taking into account the inherent risks of transmission of infections in the emergency department, the reality of staff working in this sector and Québec's existing infrastructure, with a focus on achieving best practices and the most optimal design for IPC. The evidence and concepts supporting these recommendations are presented in the section "Scientific Evidence" and cover air quality and pressure, pressure-controlled rooms, single rooms and overflow beds, triage, waiting rooms, administrative support, routine practices and additional precautions, cleaning and disinfection of equipment and the environment, maintenance of shared equipment, immunization of personnel, surveillance of infectious diseases, communication concerning infectious cases, information and electronic technology, and pest control in the emergency department.

Recommendations are rated using the rating system shown in Appendix 3. It is important to note that all Category 1 recommendations are considered important and are recommended for application; the quality of the scientific evidence that supports the recommendations is classified into levels A, B and C. Category 2 recommendations are not as strong as those in Category 1 and are suggested for application. The third rating is attributed to unresolved issues that may represent potential avenues for research. It should be noted that there is no rating from this category in this document.

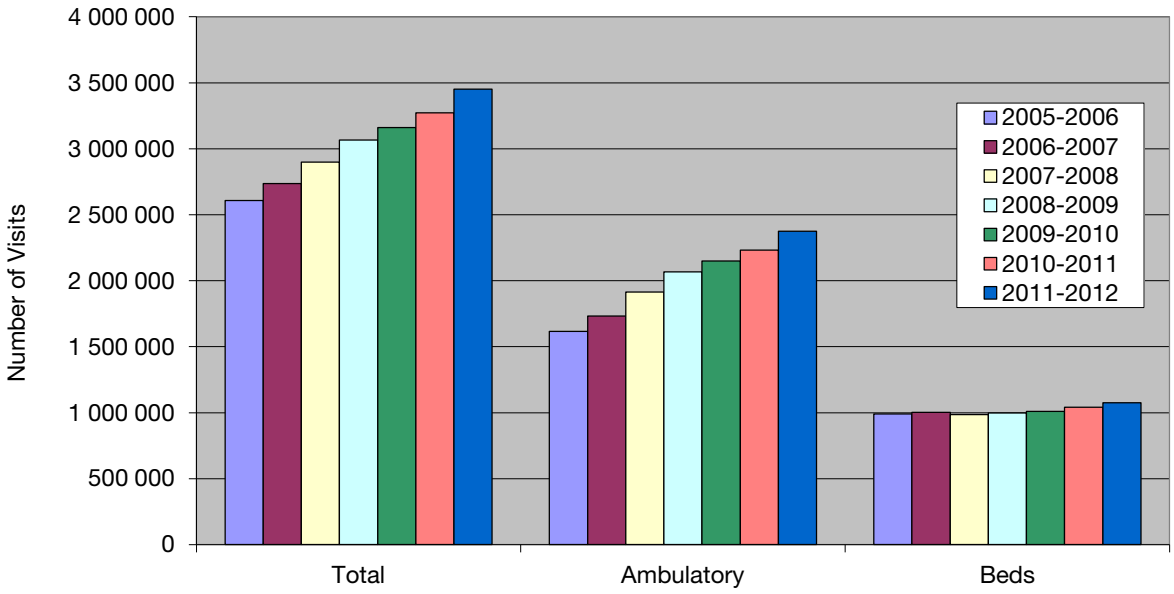
3 Current situation in Québec's emergency departments

In order to develop an overview of the current situation in Québec's emergency departments, data was obtained from the MSSS on emergency department use and patient characteristics. It is presented in the following sections. In addition, IPC professionals from hospitals in Québec that have an emergency department were surveyed in 2010 about IPC practices in the emergency department and the existing infrastructure. The information collected is included in the section "Scientific Evidence".

3.1 Emergency Department Use in Québec

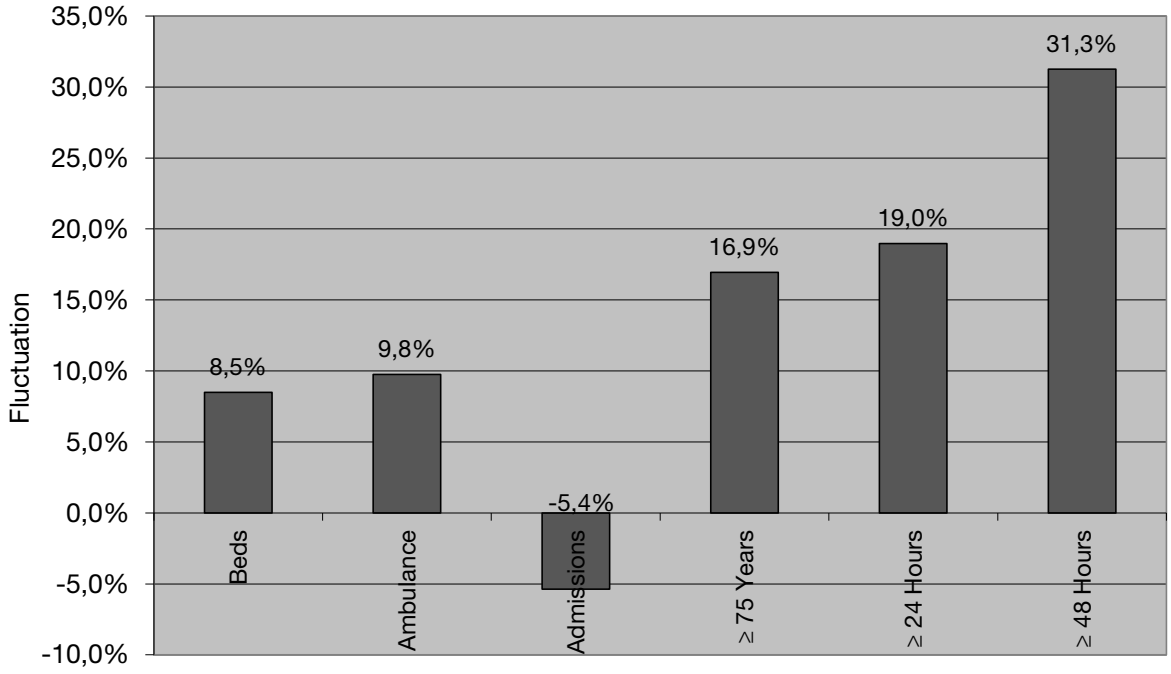
There were close to three and a half million visits to emergency departments in Québec during the 2011-2012 fiscal year; two thirds of cases were ambulatory, while one third of cases were placed in beds (personal communication, Direction nationale des urgences, MSSS, 2012)(60). Data collected from 2005 to 2012 suggest that the number of visits remained relatively stable for patients placed in beds and increased for ambulatory patients (Figure 1).

Figure 1 Total Number of Visits to the Ambulatory and ED Bed Areas of Emergency



During the same observation period, 43.1% of patients were transported by ambulance, an increase of 9.8% (Figure 2). The patient admission rate decreased by 5.4% during this period despite the increase in patients ≥ 75 years of age who now account for one quarter of patients placed in beds. For patients placed in beds, rates of length of stay of more than 24 and 48 hours increased significantly, reaching 19.0% and 31.3% respectively in 2012.

Figure 2 **Fluctuation in Rates from 2005-2012 for Various Characteristics of Patients Presenting to Emergency Departments in Québec**



4 Scientific evidence

The evidence and information obtained from the scientific literature, along with certain IPC concepts supporting the recommendations made in this scientific advisory, are presented in this section. The recommended measures associated with the scientific evidence are grouped together in boxes at the end of each section.

4.1 Air Quality

Indoor air quality in health care facilities is a concern owing to its potential health effects. The challenges are significant given various factors, such as the aging building stock, the high number of renovation and construction projects and increasing numbers of vulnerable patients. Heating, ventilation and air conditioning (HVAC) systems are designed to ensure acceptable air quality, reducing, for instance, airborne microbial contamination. Various methods can be used such as pressurization, filtration, dilution, exhaust ventilation, ultraviolet irradiation, temperature and humidity control to control indoor air quality(13, 59, 61, 62).

Canadian Standards Association (CSA) standard CSA-Z317.2-10 sets out the parameters for air changes per hour, room temperature and relative humidity requirements for each area in health care facilities(61-63). The different HVAC system components must be subject to a quality assurance program that includes routine maintenance and inspection as well as documentation of the controls performed(64).

According to this standard and the United States Facility Guidelines Institute's (FGI) *Guidelines for Design and Construction of Health Care Facilities*, the relative air pressure in the general emergency department, including corridors, examination and treatment rooms, and the resuscitation room, should be negative relative to other areas in the hospital. However, for trauma rooms whose purpose is similar to that of an operating room, air pressure should be positive relative to other areas in the emergency department(63, 65). It should be noted that in Québec, the trauma and resuscitation room in most emergency departments is not used for surgical procedures.

Air pressure in the waiting room should also be negative relative to the other rooms in the emergency department. The waiting room has a high potential for contamination, for patients may be carriers of undiagnosed infectious diseases. The air in this area should therefore be exhausted directly to the outside, without being recirculated, unless a HEPA filter has been installed in the exhaust duct(3, 65). Based on the organizational risk assessment, special measures may have to be taken in the emergency department to reduce the risk of transmission of airborne infections, including increasing air circulation and ensuring air filtration is similar to that in negative pressure rooms(65).

The triage area should be designed and ventilated to reduce exposure of staff, patients and families to airborne infectious diseases with air exhausted directly to the outside, without being recirculated, unless a HEPA filter has been installed in the exhaust duct. The FGI recommends that air pressure in emergency department triage rooms should be negative relative to adjacent areas(61, 62, 65).

A contingency plan should be drawn up in case of a malfunction of the HVAC system and include back-up power generators to maintain the ventilation system in high-risk areas (e.g., pressure-controlled rooms)(64).

Recommendations:

1 Install a ventilation system, accompanied by a quality assurance program, that complies with current norms and standards and takes into account the specific requirements of the different areas in the emergency department, including the ambulance garage. **(1A)**

44 Establish a quality assurance program to ensure the routine maintenance of ventilation systems and appropriate ventilation parameters at all times. **(1C)**

2 Install a room temperature and relative humidity control system in accordance with current standards. **(1A)**

3 Install a ventilation system and organize the physical environment so that air pressure in the emergency department is negative relative to adjacent areas. **(1A)**

50 Provide triage rooms with negative pressure ventilation. **(1A)**

82 Provide positive pressure ventilation in trauma and resuscitation rooms that are primarily used for surgery. **(1A)**

4.2 Pressure-Controlled Rooms

4.2.1 Airborne Infection Isolation Rooms

The 2003 SARS epidemic hit health care workers hard, primarily in Asia, Canada and the United States. Of the 8096 probable cases reported worldwide, the WHO reported that 21% were health care workers(66). In Toronto, the epidemic caused 44 deaths out of 270 cases (18% fatality rate), including several cases of infections acquired in emergency departments. The distribution of infected cases was as follows: health care workers 63%, patients 21%, visitors 16%. After these events, one of the Campbell Commission's recommendations was to improve patient isolation capacity in hospitals, including the creation of negative pressure rooms(67, 68). Québec was spared by this SARS episode, but the resurgence of this microorganism is still possible, as is the emergence of other equally virulent microorganisms or the misuse of microorganisms for terrorist purposes(69).

Negative pressure isolation rooms prevent contaminated air in these rooms from moving to other areas of the emergency department or hospital. This is the most efficient method for containment of infectious respiratory microorganisms(27). The Public Health Agency of Canada (PHAC) and other international bodies recommend that at least one negative pressure room be built in emergency departments to isolate patients who present with a clinical picture of an airborne respiratory infection (e.g., tuberculosis, measles, German measles, chickenpox, severe respiratory illnesses [SRI])(2, 3, 16-18, 52, 59, 64, 65, 70-73). Rebouças et al. reported that creating a negative pressure room dedicated to respiratory isolation in the emergency department is associated with a significant reduction in time from the arrival of suspected cases of tuberculosis or bacterial meningitis to the indication for isolation (from 27.5 hours down to 3.7 hours, $p = 0.018$). A decrease was also reported in time from the indication for isolation and effective isolation (from 13.2 hours down to 2.9 hours, $p = 0.003$)(74).

In fall 2010, a questionnaire was sent to 89 emergency departments in Québec to obtain an overview of the different IPC measures in place at each facility(75). The participation rate was 70.8% (63/89 respondents). There was at least one airborne infection isolation room in 84.1% of participating emergency departments (53/63)(75). Moreover, in 2007, the proportion of hospitals with a negative pressure room in the emergency department in the United Kingdom and Scotland was

24% and 8% respectively(46, 75, 76). Fusco et al. reported that in 2009, of the 41 emergency departments in the 14 European countries included in their study, the negative pressure rooms of only 6 centres (14.6%) had all the following features: anteroom, dedicated entrance, negative pressure and HEPA filtration of exhaust air(47).

Furthermore, an organizational risk assessment should be performed to determine the appropriate number of airborne infection isolation rooms(64, 65). According to Canadian tuberculosis authorities, the risk assessment should be based on the size of the facility and the number of tuberculosis patients admitted annually (Table 1). More specifically, the PHAC recommends that the number of airborne infection isolation rooms in hospitals that are considered medium risk should be based on the number of suspected active tuberculosis cases admitted annually that require respiratory isolation(59). In Canada and the United States, all suspected or confirmed cases of tuberculosis must be isolated. It is preferable to immediately isolate patients who are later found not have active tuberculosis than to fail to implement appropriate isolation precautions for patients who are later found to be contagious tuberculosis cases(59, 77).

Table 1 Risk Classification for Health Care Facilities Based on Their Size and the Number of Tuberculosis Patients Admitted Annually

Facility Size	Number of Tuberculosis Cases Admitted Annually	Risk
Hospital with > 200 beds	< 6	Low
	≥ 6	Medium
Hospital with < 200 beds	< 3	Low
	≥ 3	Medium
Other facilities, such as long-term care	< 3	Low
	≥ 3	Medium

Source: Public Health Agency of Canada(59).

The questionnaire completed in Québec in 2010 showed that the number of airborne infection isolation rooms in participating emergency departments was weakly correlated with the number of regular beds ($R = 0.486$, $p < 0.001$)(75).

The FGI recommends that airborne infection isolation rooms in the emergency department have a hand hygiene station, an appropriate area for donning and removing PPE and for storing clean and soiled materials (near the door, directly outside or inside the room). This room should also have access to a separate room with a toilet, shower (or bath) and hand hygiene station(65). Fusco et al. recommend having an anteroom to increase the efficiency of the ventilation system, provide an obstacle against pressure loss and a controlled environment for donning and removing PPE. The use of a HEPA filter to filter exhaust air is important in order to protect the environment and the people around the room(47).

In Québec, the *Guide de gestion de l'urgence* [Guide to emergency department management] recommends that one of the resuscitation areas be used as a respiratory isolation area and that airborne infection isolation rooms in the emergency department have a sink and toilet, a filtration system that complies with current standards, an alarm system that is triggered if there is a malfunction of the filtration system, adequate space to accommodate a mobile X-ray system and a vestibule where clothing and equipment can be kept(1).

Recommendations:

4 Provide at least one airborne infection isolation room, with a toilet and sink (in addition to the one in the trauma and resuscitation area). **(1A)**

5 Provide an adequate number of airborne infection isolation rooms relative to the number of regular beds in the emergency department, based on the organizational risk assessment, the organization's mission and the level of care provided. **(2)**

81 Provide a bed in an airborne infection isolation room in the trauma and resuscitation area that can be used for patients with a clinical picture of a transmissible respiratory infection. **(1A)**

6 When constructing a new emergency department or redesigning an existing emergency department, the airborne infection isolation room should be situated in such a way that the patient occupying the room does not circulate among beds or in other areas where many people are gathered. **(1B)**

8 Ensure that a monitoring system with an alarm is installed in airborne infection isolation rooms and protective environment rooms, where applicable, to signal any malfunction of the ventilation system that would lead to a reduction in the pressure differential. **(1A)**

4.2.2 Protective Environment Rooms

In addition to airborne infection isolation rooms in the emergency department, several organizations, including the FGI and the Centers for Disease Control and Prevention (CDC), recommend having a protective environment room equipped with an anteroom for immunocompromised patients. This type of room is designed to protect patients with an impaired immune system (e.g., organ transplant recipients, immunosuppressed patients, neutropenic patients, etc.) from infectious microorganisms suspended in the air commonly found in the environment, such *Aspergillus* spp. spores, by reducing their counts in the air in the room(64, 65, 68, 78). The main differentiating factors between a protective environment room and other rooms are the prerequisites for air filtration (HEPA filter installed in the air intake duct), positive air pressure relative to adjacent areas and the number of air changes per hour(65). It is imperative that pressure in this type of room be monitored to ensure appropriate pressure differentials and air changes at all times(79).

An organizational risk assessment should be performed to determine the appropriate number of protective environment rooms in the emergency department(65).

Recommendation:

7 Provide protective environment rooms, with a toilet and sink, based on the organization's needs, mission and patient characteristics. **(1A)**

4.3 Single Rooms with a Private Toilet

A higher number of roommate exposures increases the risk of in-hospital transmission of VRE, MRSA, norovirus and *C. difficile*(55, 80-82). Shared rooms may, for instance, have a negative impact on health care providers' compliance with hand hygiene, since the proximity of patients means that health care providers tend to move from one patient to another without performing hand hygiene(83). In 2006, the coroner in charge of the inquiry into the *C. difficile* outbreak at Honoré-Mercier Hospital pointed out "l'impact négatif de la promiscuité de la clientèle engendrée par la pénurie de chambres

individuelles, de chambres d'isolement et de salles de toilette dans les unités de soins et à l'urgence" [the negative impact of patient proximity caused by the shortage of single rooms, isolation rooms and washrooms in patient care units and the emergency department](80, 84).

Single rooms provide more privacy, increase patient satisfaction, reduce the risk of cross-infection and allow greater flexibility during invasive procedures(80). Experts from the United Kingdom reported their findings on the determinants influencing decisions on single room provision in a health care facility(85). They report that some countries target 50% single rooms, while others tend to move towards 100%. Notwithstanding concerns over IPC and the possibility of new pandemics, a number of other determinants are taken into account. A lower limit of 50% has emerged in response to public expectations, changes toward a more patient-focused environment as well as experience and new knowledge in regard to modern health care. The trend towards 100% single room provision calls for a paradigm shift to more privacy and a higher quality patient environment, an orientation which appears to be stable and durable.

In Québec and Canada, a high proportion of single rooms with private toilets is recommended in hospitals(10, 80, 86). The Agence d'évaluation des technologies et des modes d'intervention en santé (AETMIS)[4] issued an information brief in October 2007 entitled "Utilisation de chambres simples et de chambres doubles pour le contrôle des infections nosocomiales" [Use of single rooms and double rooms for healthcare-associated infection control](86). It says that despite the lack of rigorous scientific evidence, the single room with private bathroom and toilet plays an important role in resolving the issue of cross-infections. It should be noted that AETMIS' argument does not concern emergency services specifically, but the known benefits of single rooms could apply to emergency department beds, considering the following elements:

- easier cleaning and decontamination of surfaces;
- development of conditions conducive to better hand hygiene standards (sink in the patient's room);
- more space between patients;
- easier to isolate patients if necessary;
- private toilets are necessary to contain outbreaks of *C. difficile* or norovirus.

In Ireland, it is recommended that newly built acute hospital facilities should be made up entirely of single patient rooms, that these single patient rooms should all have a shower, a toilet and a sink near the door. For emergency departments, it is recommended that a proportion of stretcher spaces should be constructed using moveable transparent walls to facilitate conversion to partially open cubicles, or cohorting of multiple patients, to allow for changes in requirements for urgent interventions(72).

The CINQ recommends that for new constructions, 100% of hospital rooms should be single rooms with a private toilet. The number of single rooms with a private toilet should be maximized during construction or renovation work. All emergency departments should have an adequate number of single rooms with a private toilet in order to allow additional precautions to be applied(80).

In Québec, in 2010, it was reported that the mean number of beds in emergency departments was 22 (range 5–56) and that an average of 30% of these beds were in single rooms. However, the number of single rooms was weakly correlated with the number of regular beds ($R = 0.408$, $p < 0.001$)(75).

[4] On January 19, 2011, AETMIS was renamed the Institut national d'excellence en santé et en services sociaux.

This suggests that there may be greater proximity between patients in some emergency departments.

The experience of Mount Sinai Hospital in Toronto during the SARS outbreak of 2003 showed that emergency department infrastructure contributes to the transmission of infections. After this epidemic, all areas used for stretchers in hallways were condemned and many cubicles separated by a curtain were closed. Furthermore, the hospital modified its resuscitation room which initially had two separate rooms (with two stretchers in each), creating spaces with one stretcher per room(87). In certain situations specific to emergency care, it may, however, be necessary to accommodate more than one patient at a time in the same trauma and resuscitation room so that health care staff can move easily from one stretcher to the next(65).

Certain microorganisms remain in the environment, including *C. difficile*, VRE and MRSA spores(88-91). Sharing a toilet with other patients can contribute to the transmission of enteric pathogens such as *C. difficile* and norovirus. A person may, in fact, contaminate himself by touching surfaces or objects soiled by microorganisms and then bringing his hands to his mouth(82). It should be noted that the document's authors did not find any studies that examined the association between shared toilets in the emergency department and the incidence of healthcare-associated infections.

Few organizations have made specific recommendations regarding the ratio of beds with a private toilet in the emergency department. In the United States, since 2010, it has been recommended that intensive care unit rooms in new constructions have direct access to a bathroom or toilet in a ratio of one to two. This change was intended to increase patient privacy and decrease staff exposure to contamination(92). The *Guide de gestion de l'urgence* recommended that 50% of rooms in emergency departments in Québec should be closed rooms and that half of these should have a private toilet(1). In addition, toilet rooms with a sink, soap dispenser and paper towel dispenser should be provided near examination and treatment rooms and in the emergency department waiting room(3, 65).

In a study in Québec, the number of toilets in participating emergency departments was moderately correlated with the number of regular beds ($R = 0.622$, $p < 0.001$)(75). This suggests that toilets may be shared by more people in some busier emergency departments.

Recommendations:

70 For new constructions and for renovations to an existing emergency department, the target should be 100% single rooms that can be closed by a glass door. **(1B)**

72 A ratio of 50 to 100% of closed rooms should have a private toilet with a sink. **(1C)**

73 For emergency departments with beds without a private toilet, provide a minimum ratio of one toilet with a sink for every five beds. **(1C)**

65 Provide an adequate number of toilet rooms near examination and treatment rooms. **(2)**

4.4 Overflow Beds

Hospitals use overflow beds when regular beds are all occupied. These beds are often located in the corridors of emergency departments and, sometimes, in an unoccupied room or area of the hospital. The *Guide de gestion de l'urgence* recommends doing away with patient care areas in corridors(1).

The same IPC norms and standards should apply to all beds (e.g., HVAC systems, cleaning and disinfection, ABHR dispensers, availability of PPE, etc.)(93, 94).

Proximity between an infected source and a potentially susceptible host increases the risk of spreading contagious microorganisms. Infectious droplets can be propelled up to one to two metres(5, 95, 96).

This is why spatial separation or a protective barrier can reduce the risk of infection when two patients are occupying adjacent beds. The CDC recommends spatial separation of at least three feet (one metre) between beds in a room occupied by patients with infections transmitted by the droplet route(95). Li et al. recommend that the space between beds should be greater than the distance droplets can travel, i.e., more than one and a half metres(96). The PHAC recommends spatial separation of two metres between patient beds(5).

The Comité des immobilisations en prévention des infections nosocomiales (CIPIN) (Healthcare-associated infection prevention building committee) recommends a minimum distance of one and a half metres between beds if there is no protective barrier in operational units in areas that receive patients, in particular ambulatory care areas such as the emergency department(97).

Recommendations:

11 Apply the same IPC standards to overflow beds and regular beds. **(1A)**

76 Allow a distance of one and a half to two metres between beds that are not in closed rooms (e.g., overflow beds in the corridor). **(1B)**

4.5 Triage

Triage is the process of determining the level of priority for medical assessment based on the nurse's assessment of a patient's condition(1). In triage, the patient's presenting complaint is determined, the vital signs taken and an appropriate rapid assessment done to determine the level of priority for access to medical treatment.

After triage, a level of priority is assigned (I to V) using the Canadian Triage and Acuity Scale (CTAS) (Table 2). The CTAS is based primarily on the patient's presenting complaint(98). This system is used to standardize the triage process by using the same criteria and the same method of classification for adults, children and people with a physical or mental health problem(1).

Table 2 Triage Levels on the Canadian Emergency Department Triage and Acuity Scale

Triage Level	Time to Nurse	Time to Physician	Sentinel Diagnosis	Fractile Response	Expected Admission Rate
I - Resuscitation	Immediate	Immediate	Cardiac arrest	98%	70-90%
II - Emergent	Immediate	< 15 minutes	Chest pain	95%	40-70%
III - Urgent	< 30 minutes	< 30 minutes	Moderate asthma	90%	20-40%
IV - Less urgent	< 60 minutes	< 60 minutes	Minor trauma	85%	10-20%
V - Non urgent	< 120 minutes	< 120 minutes	Common cold	80%	0-10%

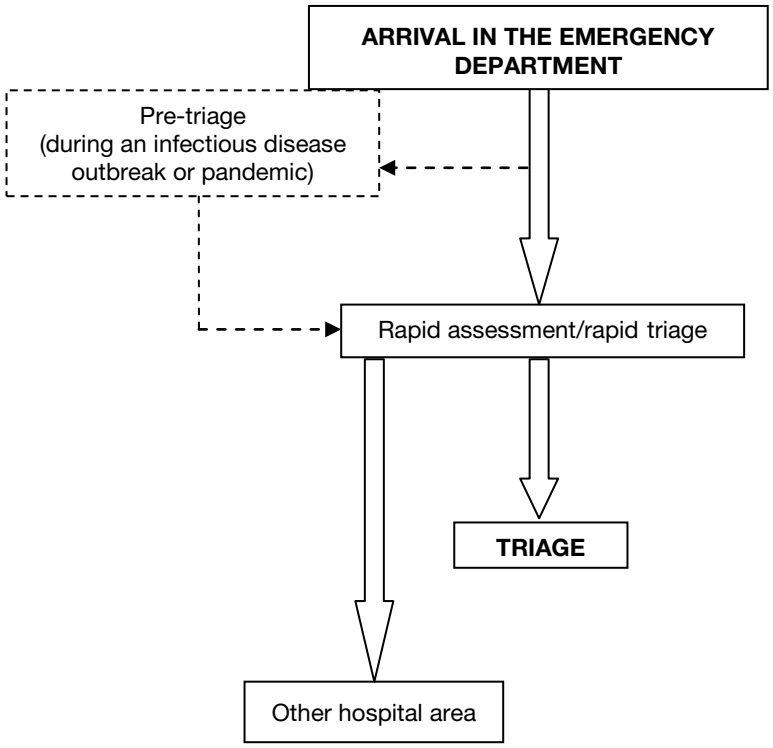
Sources: The Canadian Association of Emergency Physicians and Beveridge et al.(99, 100).

The higher the triage level (e.g., P1), the shorter the time to assessment by either a nurse or a physician. The fractile response is the proportion of patients in each triage level seen within the time objective for that level(100). Most patients spend a few minutes or a few hours in the emergency department waiting room until they are called to an examination room. Once the patient has been seen, he will follow one of these pathways (Appendix 1):

- he is discharged and leaves the hospital;
- he is directed to investigation rooms (then to the waiting room to await the results);
- he is kept under observation (in the ED bed area) for tests or procedures;
- he is directed to the resuscitation room for immediate treatment;
- he is assigned to a bed on a unit (but may be directed to an ED bed while waiting for the room to become free);
- he is taken to the operating room (and then brought to the recovery room while waiting for a bed to become free).

A pre-triage step may be added before triage, when the situation requires, for example, during an infectious disease outbreak or pandemic (Figure 3). Patients are asked specific questions related to the problem situation as soon as they arrive in the emergency department. This step can be done outside the facility if necessary. Furthermore, a rapid assessment or rapid triage may be introduced in some emergency departments when the type of patient requires more rapid treatment, for example, in pediatrics, or during peak times. The *Guide de gestion de l'urgence* specifies that the facility's physical layout should allow this step to be performed when necessary(1).

Figure 3 Triage Steps in the Emergency Department



When patients present to the emergency department with infectious symptoms, the nature of the infection is not always known when they arrive. Depending on the epidemic season, there may be cases of respiratory infections such as influenza, cases of infectious rotavirus or norovirus gastroenteritis, or cases of invasive group A streptococcal or meningococcal infections(21-25, 27, 101-106). The emergency department also sees patients with other infectious diseases such as tuberculosis, SARS, measles, the plague, anthrax(16-18, 37-40, 43, 45, 107). Pediatric patients may be affected by particular pathogens, such as RSV, the chickenpox virus, the measles virus or the whooping cough bacillus(108-111).

Front-line health care workers may be exposed to pathogens because they are among the first to have contact with patients(52). To reduce the risk of transmission of infectious diseases at the initial point of patient encounter in the health care setting, many organizations recommend having a physical barrier in the registration area made of sturdy, transparent material (e.g., plexiglass) with a small opening for communication as well as a closed room in the rapid assessment and triage areas, in order to limit staff exposure to droplets and curb the spread of infections(1-3, 52, 112-115). However, this barrier should not interfere with the health care team's ability to observe patients awaiting treatment. The triage area should be situated so that staff can control access to the emergency department's main entrance, waiting room and treatment areas(65).

The SARS epidemic in 2003 showed that emergency departments are well positioned to identify and manage infectious diseases. It also underscored the importance of implementing triage strategies(17, 27). Various IPC measures were implemented at the time to limitnosocomial transmission of the virus. Yen et al. reported that the creation of fever screening stations outside emergency departments in Taiwan was the most important factor in preventing nosocomial transmission of SARS to health care workers(116). In Singapore, the sensitivity and specificity of a questionnaire specifically developed to

identify SARS cases were 89.4% and 89.7% respectively. The use of this questionnaire and a set of admission criteria allowed most patients to be screened and treated safely(117).

In addition to the physical organization of the facility, a system to rapidly identify infected patients should be established to help reduce the risks of transmission. Infectious disease symptoms do not modify the CTAS score; therefore there is no connection between a patient's infectious status and the level of priority assigned. However, the *Guide de gestion de l'urgence* specifies that a system allowing potentially contaminated patients to be directed to a designated area should be implemented in the emergency department(1). According to Fusco et al., triage procedures should not only include an assessment of disease severity and urgency, but should also consider the risk of disease transmission posed by patients(47).

The CDC recommends developing and implementing systems for the early detection and management of potentially infectious persons at initial points of encounter, for instance, the triage areas in emergency departments(95). In Québec, rapid triage procedures to assess all patients' infectious risk have already been implemented by a number of health care settings (Figure 3)(73). Québec's Comité protection urgence pandémie influenza [Committee for health care worker protection in the emergency department during pandemic influenza] recommends performing a rapid assessment of patients using a screening tool when they arrive in the emergency department to determine the care required and isolate suspected influenza cases. This recommendation is based on international pandemic preparedness plans and was ratified by the Association des médecins d'urgence du Québec (Quebec association of emergency physicians), the Association des spécialistes en médecine d'urgence du Québec (Quebec association of emergency medical specialists) and the Association des infirmières et infirmiers d'urgence du Québec (Quebec association of emergency nurses) (52, 118-121).

The colonization status of patients infected with an antibiotic-resistant microorganism should also be identified rapidly so that carriers are not placed near other susceptible patients(106).

On arrival in the emergency department, every patient should immediately be asked if he has a fever (or symptoms that suggest fever) or cough, especially during the peak influenza season. Staff must be able to identify patients with influenza-like illness (ILI) as well as SRIs and know what measures to apply to prevent transmission(106, 122, 123). Triage nurses should instruct patients to observe respiratory hygiene / cough etiquette(106).

Depending on the epidemiological situation, it may be necessary to have a simple, standardized form available with additional questions that can be used for rapid triage or a rapid assessment, for example, questions about travel in the previous weeks or possible contact with a sick person before travelling to an at-risk destination, occupational risks (e.g., the patient is a veterinarian, a laboratory worker) or about a history of being part of a cluster(47, 73). In 2010, most of Québec's emergency departments (> 90%) that participated in a study reported that their triage form included questions on antibiotic-resistant microorganisms such as MRSA and VRE.

A pre-triage system is sometimes implemented when rapid triage proves difficult during busy periods in the emergency department, such as during an outbreak of respiratory infections (e.g., influenza), an outbreak of gastroenteritis (e.g., norovirus) or in any other epidemiological situation, based on the judgement of IPC personnel (Figure 3)(73, 82). The CINQ's prevention and control measures for pandemic influenza A(H1N1) recommended implementing a pre-triage service in the emergency department, i.e., a triage area that is separate from the emergency department triage area, to direct patients with ILI to the most appropriate treatment area for their needs(124).

In addition to implementing an early identification system for at-risk cases, staff training and the communication of information on the epidemiological situation are crucial elements. Fusco et al. reported that 41.5% of emergency departments that participated in their study did not have triage staff who were adequately trained in the recognition of potentially infected patients. The authors recommend that triage staff be specifically trained to recognize suspected cases of infection in order to effectively implement IPC protocols and procedures when the situation requires. They also suggest that one member of staff from the emergency department or IPC committee should be responsible for updating the main Web sites that issue epidemiological alerts and bulletins and disseminating the relevant content to triage staff(47). In Québec, responsibility for notifying health care facilities about infections, outbreaks or any other infectious problems is usually assumed by regional public health authorities, while facilities are responsible for disseminating information internally. Triage staff should also be informed and educated about the increasing prevalence of antibiotic-resistant microorganisms and the characteristics of infections associated with these microorganisms(32, 51, 125).

Recommendations:

49 Provide a physical barrier in the registration area between patients and staff. **(1B)**

51 Implement a pre-triage system during busy times or a community outbreak. **(1B)**

53 Upon arrival, immediately assess patients for fever, cough, skin rash, diarrhea, vomiting or any other symptoms that suggest a clinical picture of infection in order to promptly implement appropriate additional precautions. If a patient has these symptoms, immediately collect further information, such as history of travel and infectious contact. **(1A)**

52 Establish a system to rapidly direct patients to the appropriate area of the emergency department based on their presumed infectious status (e.g., airborne infection isolation room, designated waiting room, etc.). If an airborne infection is suspected (e.g., tuberculosis, chickenpox, measles, SRI), promptly direct the patient to an airborne infection isolation room in the emergency department or to a unit where this type of room is available. **(1A)**

Arrival by Ambulance

54 If a patient with a clinical picture of a transmissible infection arrives by ambulance, ensure that ambulance workers give the information to emergency department staff so that IPC measures are implemented immediately. **(1B)**

4.6 Waiting Room

4.6.1 Toys in the Waiting Room

Toys are a source of distraction, comfort and security for children. Shared toys are, however, a source of concern, for toys in hospitals may be contaminated, in particular by *S. aureus* (including MRSA) and *Pseudomonas* spp.(126-128). During the flu season, influenza A viral ribonucleic acid (RNA) was detected on porous objects and surfaces in homes and daycare centres (50% of surfaces tested positive)(129). Furthermore, respiratory viral RNA was found on toys in pediatric office waiting rooms, most commonly picornaviruses (including rhinoviruses and enteroviruses)(130). One study showed that toys made from hard materials such as plastic had lower levels of contamination than soft toys(126, 131).

The CDC believes that shared toys in hospitals may become a vehicle for transmitting respiratory viruses, such as RSV, or pathogenic bacteria such as *P. aeruginosa*(95). In daycare centres, it has been shown that rotavirus can be transmitted by indirect (fecal-oral) contact when a child mouths a toy(51).

Furthermore, congregation of children in play areas in the waiting room increases proximity between infected children and others who are not infected and allows toys and bodily secretions to be easily shared, increasing the risk of transmission(95). In Québec, it is recommended that emergency department waiting rooms should not have a play area in order to prevent indirect contamination as a result of sharing toys(1, 3).

Recommendation:

63 Do not permit toys in the waiting room. **(1B)**

4.6.2 Books and Magazines in the Waiting Room

Limited evidence was found in the literature review regarding the contamination of magazines and leaflets in hospital waiting rooms(132). However, available scientific knowledge of the transmission of viruses from the contaminated environment can be applied to the issue of contamination of waiting room magazines in emergency departments.

In vitro studies have shown that human viruses, such as rotavirus and adenovirus, are able to survive for extended periods on various types of materials, including paper(133-135). Once deposited on surfaces, viruses dry and are believed to be more resistant than suspended viruses. Some viruses can be transmitted from a contaminated surface to the mouth, eyes and nose via the hands, in particular rhinoviruses, rotaviruses and adenoviruses(136).

To reduce the risk of virus transmission from contaminated surfaces, it is important to clean and disinfect these surfaces thoroughly, especially in hospitals where the level of environmental viral contamination may be high. The use of virucidal disinfectants is appropriate for certain viruses, such as rhinoviruses, RSV, rotaviruses and adenoviruses(136). However, waiting room magazines in an emergency department cannot be cleaned and disinfected(137).

Thus it appears that viral infections can be acquired by nosocomial transmission from the environment to the hands and that various microorganisms can survive on paper. Despite the lack of specific data on this type of transmission, experts recommend that magazines should not be permitted in the waiting rooms of health care facilities. Alternative measures can be considered.

Recommendations:

64 Do not permit books and magazines in the waiting room. **(2)**

62 Disseminate educational messages on IPC (e.g., respiratory hygiene / cough etiquette, hand hygiene). **(2)**

4.6.3 Designated Waiting Room for Patients with a Clinical Picture of a Transmissible Infection

Proximity between an infected person and a potentially receptive host increases the risks of transmission of contagious microorganisms(2, 51, 71, 138). A review of the literature showed that proximity between norovirus-infected patients and other patients is associated with increased

infection risk(81). Exposure at a distance of less than one metre between patients was associated with increased risk of transmission of droplet-transmissible microorganisms (e.g., *Neisseria meningitidis*, group A streptococcus) and supports the practice of separating infected patients from other patients(95, 139). The implementation of such measures in crowded waiting rooms is challenging and in most settings requires planning and additional financial resources to organize appropriate additional space(140).

A separate waiting room should be provided for patients with symptoms of respiratory infections who are potentially contagious(1, 3, 124). Patients with diarrhea or vomiting should ideally be grouped together in a closed room with a toilet or in a room separate from the common waiting room(73). People with or suspected of having an infection caused by a microorganism transmitted by the airborne route, such as tuberculosis, measles, an SRI of infectious origin, chickenpox or disseminated herpes zoster, should not wait in a common waiting room before being seen. Immunocompromised patients should not wait in a common waiting room(138, 141).

If a separate waiting room cannot be provided for patients with a transmissible respiratory infection, a section of the main waiting room should be set aside for cohorting of patients with respiratory symptoms (fever, cough), ensuring they remain at least one and a half to two metres apart, especially during an outbreak. Spatial separation of at least two metres should be maintained between symptomatic people and other people if there is no physical barrier(2, 73, 124, 142-144).

In 2010, 54 out of 63 (87.1%) Québec hospitals that completed a questionnaire on IPC practices in emergency departments had a designated area in their emergency department waiting room(75). This figure is higher than that reported by Fusco et al.; 53.6% of European emergency departments that participated in their study had a designated area in the waiting room for patients with a clinical picture of infection, while 34.1% had a common waiting room that was large enough to ensure safe patient separation (at least one metre)(47).

Recommendations:

55 Provide a separate waiting room for cohorting of patients with a clinical picture of a transmissible respiratory infection. **(1A)**

56 If there is no designated waiting room, designate a separate area in the main waiting room, separated by a physical barrier, for cohorting of patients with a similar clinical picture of transmissible infection and limit contact between patients. **(1B)**

58 Provide an adequate number of toilets for all patients in the waiting room, including the designated waiting room, taking capacity and volume of users into account. **(2)**

61 Provide a designated toilet for patients with a clinical picture of infectious gastroenteritis during a community outbreak and increase the frequency of cleaning and disinfection. **(1B)**

4.6.4 Respiratory Hygiene / Cough Etiquette in the Waiting Room

See the section Respiratory Hygiene / Cough Etiquette (4.12.2).

4.7 Clean and Soiled Utility Rooms

A number of agencies recommend having physically separate clean and soiled utility rooms. These rooms should also be physically separate from all other areas in the emergency department and reserved for the emergency department's exclusive use. The soiled utility room should have a work counter for the initial cleaning and disinfection of various instruments and equipment as well as space for storing covered containers used for soiled bedding and various other types of waste(1, 65).

Other design criteria for soiled utility rooms were developed and revised by the Comité des immobilisations en prévention des infections nosocomiales (CIPIN) in June 2012, namely, soiled utility rooms must comply with reprocessing procedures for medical equipment in order to prevent cross-contamination of soiled and clean equipment and units must be situated so as to minimize the distance from the patient's bedside to the soiled utility room for health care teams and soiled equipment. Negative pressure must be maintained in the soiled utility room relative to the corridor and 100% of the air must be vented to the outside of the building(97).

Recommendation:

15 Provide physically separate clean and soiled utility rooms

4.8 Decontamination Area for Receiving Potentially Contaminated Patients

The *Guide de gestion de l'urgence* recommends providing a decontamination area for people who may have been in contact with hazardous materials, in particular biological agents(1). Ideally, the decontamination area should be a closed room, located in the garage, and should have the necessary equipment.

The FGI recommends that a decontamination room should be included in the design and construction of new emergency departments. This room should have an entrance leading directly outside, a door to the emergency department, a shower and a drain in the floor as well as a sink, an ABHR dispenser and PPE available at the entrance. Waste water must be collected and drained safely so that contaminated water does not enter community drainage systems. The room must be designed as an airborne infection isolation room; the air should therefore be exhausted to the outside without recirculating in the hospital(65).

Recommendation:

16 Provide a decontamination area, ideally a closed room, adjacent to the emergency department garage to receive people who have been in contact with hazardous materials. **(1A)**

4.9 Clothes Hooks

Laboratory coats as well as the coats and jackets of staff or visitors must be taken off before entering an isolation room and before donning PPE(145). Clothes hooks should be placed near each bed space and examination and treatment rooms(1).

Recommendations:

66 Provide an adequate number of clothes hooks in each examination and treatment room. **(2)**

77 Provide an adequate number of clothes hooks outside each bed space. **(2)**

4.10 Monitoring and Restriction of Traffic in the Emergency Department

The layout of the emergency department must allow staff to monitor access at all times. The emergency department should have designated entrances, separate from the facility's main entrance, to prevent unnecessary and inappropriate traffic (3, 65). Depending on the epidemiological situation (e.g., flu season), a number of agencies recommend minimizing traffic, including visitors and hospital staff(1, 13, 52).

Recommendation:

13 Provide entrances reserved solely for the emergency department so that the entrance is not used to access other areas in the hospital and restrict traffic at all times (day, evening, night). **(1A)**

4.11 Administrative Support for the Application of IPC Measures

The CDC recommends making IPC a priority for health care organization administrators and providing fiscal and human resources to maintain IPC programs(95). Administrators play a key role in implementing and promoting the application of the highest IPC standards in emergency departments(146).

Siegel et al. stress the importance of administrative support in combating multi-resistant pathogens. Administrator involvement facilitates the implementation of the necessary interventions, including implementing new communication systems, providing the necessary number of sinks and ABHR dispensers, maintaining appropriate staffing levels for the intensity of care required and encouraging adherence to recommended IPC practices(78). Gardam et al. noted that healthcare-associated infections are patient safety indicators. By giving constructive criticism, administrators can have an impact when audits of compliance with IPC are performed and the findings are shared with staff(83).

The Aucoin report stressed that the health care facility's chief executive officer and board of directors are responsible and accountable for the prevention of healthcare-associated infections. They must express their concern in this regard in their priority setting, resource allocation decisions and IPC outcomes monitoring(147). The Society for Healthcare Epidemiology of America (SHEA) believes various stakeholders in health care settings are responsible for applying IPC measures, encompassing the hospital's senior management, administrators, health care personnel (physicians, nurses, therapists), laboratory personnel and the patient and his family(148).

Administrators also have a role to play in the application of staff screening and immunization programs for certain infectious diseases(51, 146, 149).

In Québec, the *Guide de gestion de l'urgence* specifies that the emergency department's medical director and head nurse must ensure that the measures necessary for IPC are implemented and observed(1).

Recommendation:

17 Ensure management and administrators support the application of IPC measures in the emergency department. **(1A)**

4.12 Routine IPC Practices

Routine IPC practices are a set of infection prevention and control measures recommended by numerous agencies, including the PHAC. These measures must be applied by health care personnel during patient care to prevent and limit the transmission of microorganisms(150, 151). Orderlies and other professionals who have contact with patients or may have contact with blood, body fluids, secretions or excretions must have knowledge of these measures. They reduce the risk of transmission of pathogenic microorganisms from blood, body fluids, secretions and excretions (except sweat), non-intact skin and mucous membranes(152).

These practices must be incorporated into the routine care of all patients in health care settings, at all times and in all departments, including the emergency department. Routine practices set out procedures for point-of-care risk assessment, hand hygiene, source control (triage, early diagnosis and treatment, respiratory hygiene / cough etiquette, spatial separation), patient placement, aseptic techniques, use of PPE, safe use of sharps, management of the patient care environment, patient, family and visitor education, and management of visitors(5, 47, 73).

The SARS epidemic in Canada highlighted the importance of strict adherence to IPC measures and a high level of preparedness in emergency departments to prevent the transmission of respiratory and emerging infections(140). Even before the WHO issued its first alert in March 2003, three travellers infected with the SARS virus had arrived in Canada, one in the greater Toronto area and two in the Vancouver census metropolitan area. The greater ability to contain transmission in Vancouver's emergency departments compared with those in Toronto has been related to coordinated efforts to implement routine practices in the emergency department, reinforced through timely public health alerts. Periodic infection control audits also mitigated the outbreak(153).

All of the studies reviewed on compliance with routine IPC practices in the emergency department reported low compliance rates(51, 71, 140, 154, 155). High workload, high intensity of care and understaffing are frequently mentioned as limiting factors(140, 156-160). Promoting the application of these practices at all times in the emergency department by health care teams is often cited as a determining factor in increasing compliance(51, 116, 146). At the Johns Hopkins University in Baltimore, following the introduction of an institutional policy mandating compliance with universal precautions accompanied by audits, compliance with universal precautions in the emergency department improved from 48 to 81%(149).

By routinely applying standard precautions and initiating additional precautions based on patients' medical condition, emergency department staff play a key role in reducing the transmission of antibiotic-resistant microorganisms. Emergency department staff should therefore be familiar with their facility's specific IPC protocols, policies and procedures(47, 106).

Recommendations:

18 Ensure routine practices and additional precautions are implemented when indicated and provide training and documentation on these measures. **(1A)**

10 Ensure there is sufficient space to install IPC equipment for patients and staff (e.g., ABHR dispensers, disinfectant wipes, masks, gowns, gloves, tissues, no-touch waste receptacles). **(1A)**

21 Ensure the necessary equipment is available for the implementation of routine practices, respiratory hygiene / cough etiquette and additional precautions. **(1A)**

46 At a minimum, provide containers for waste and soiled material at all points of care. **(1B)**

67 Store equipment in examination and treatment rooms in closed cupboards or drawers to reduce the risk of contamination. **(1B)**

84 Keep only the necessary amount of equipment in the trauma and resuscitation room and store extra supplies in closed cupboards to reduce the risk of contamination. **(1B)**

4.12.1 Hand Hygiene

Hand hygiene is one of the key components in preventing infections spread by direct or indirect contact(51, 161). The infrastructure needed to practice hand hygiene should be provided at all points of care in the emergency department. ABHR dispensers should be placed in appropriate locations in all areas of the emergency department, except for areas where patients have cognitive problems or behaviours that could compromise their safety. Access in strategic locations to one or more sinks, preferably with faucets activated by the foot, wrist, knee or a magic eye, is also recommended. ABHR, soap and paper towels should be available at all times and supplies adjusted during busier periods(1-3, 65, 73, 124).

In Québec in 2010, it was reported that sinks or ABHR dispensers were available in the immediate environment of beds in 57.1% (36/63) of participating emergency departments(9).

Audits are recommended to measure compliance with hand hygiene in emergency departments(51, 146, 162). The WHO developed a tool that identifies five moments for hand hygiene(163). In Canada, this strategy has been simplified into four moments:

1) before initial patient or patient environment contact;
2) before aseptic procedure;
3) after body fluid exposure risk;
4) after patient or patient environment contact(94).

This way of breaking down the moments when hand hygiene should be practiced should be the focus of audits so that compliance can be measured at each moment(164).

Audits should include a step where feedback is provided to professionals, emphasizing staff accountability. Abela et al. reported that performing audits and providing feedback to professionals improved hand hygiene compliance rates from 15.3 to 67.8% ($p < 0.001$) on one of the units in their study(165). Steed et al. used the WHO's audit method to measure ABHR use in the emergency department and suggest that their data can be used as denominator estimates to calculate hand hygiene compliance rates in the emergency department. Depending on the size of the emergency

department, the number of hand hygiene opportunities per bed hour were found to differ significantly, ranging from 1.84 to 5.03 ($p < 0.05$)(162).

Many authors have reported that hand hygiene compliance rates are lower in the emergency department, often below 40%, compared with other hospital wards(71, 156, 160, 166-168). A recent review of the literature reported that the average rate of hand hygiene compliance was lower among physicians (32%) than nurses (48%) in all units(95). Adherence to hand hygiene procedures was generally lower before contact than after (21% and 47% respectively)(30, 157, 166). In Québec, compliance with hand hygiene practices was found to be under 50% in 90% of participating emergency departments (hand hygiene audits were performed in 35 out of 65 participating emergency departments, or 55.6%)(75). Improving compliance with hand hygiene in the emergency department appears to be difficult; despite the implementation of strategies targeting health care personnel in these departments, it remains low(166, 167).

Compliance with hand hygiene is influenced by the availability of ABHR and peer behaviour. Larson demonstrated that touch-free ABHR dispensers were used significantly more often in the emergency department(171). Haas demonstrated that the use of wearable ABHR dispensers by health care staff in the emergency department did not have an impact on compliance with hand hygiene, which remained at 40%(169, 170). Lankford et al. reported that the presence of a senior member of the health care team who did not perform hand hygiene had a negative influence on compliance with hand hygiene for other staff (odds ratio [OR] 0.2, $p < 0.001$)(171).

One of the factors that positively influences adherence to hand hygiene procedures is providing and repeating information to staff regarding the measures to apply(93). In Australia, television screens were installed in emergency department waiting rooms to display messages to this effect(172).

Venkatesh et al. reported that placement of patients in hallways in the emergency department was the strongest predictor of poor compliance with hand hygiene in the emergency department. They suggest that this could be due to environmental factors, such as the lack of ABHR dispensers in corridors or other factors related to emergency department overcrowding(173).

Recommendations:

22 Provide ABHR dispensers at all points of care, in all strategic areas and in designated staff areas and ensure they are kept filled. **(1A)**

75 Provide ABHR dispensers at the point of care for each bed, including overflow beds. **(1A)**

74 Provide an adequate number of sinks in the ED bed area and in designated staff areas. **(1A)**

19 Ensure staff, patients and visitors comply with hand hygiene. **(1A)**

4.12.2 Respiratory Hygiene / Cough Etiquette

Respiratory hygiene / cough etiquette is intended to prevent the transmission of respiratory infections in health care facilities. It comprises a set of IPC measures for patients, visitors and health care workers: education, posted signs with instructions to patients and visitors, source control measures (covering the nose and mouth when coughing, wearing a mask), hand hygiene after contact with secretions and spatial separation of symptomatic persons(95).

The application of respiratory hygiene / cough etiquette is imperative in the emergency department to limit the spread of respiratory pathogens. This measure should always be implemented as soon as patients arrive, in the waiting room, the examination and treatment room and for the entire hospital pathway, in particular during periods of heightened respiratory alert(27, 174).

Longtin et al. reported that frequency of mask use by coughing patients was low (27%) in the emergency department. The reasons given for not using a mask were a long waiting time, discomfort and a delay between admission and being instructed to wear a mask. Being given instructions on mask use directly by a health care worker would improve compliance with mask use in patients(175, 176).

The information given to patients should provide a general description of respiratory hygiene / cough etiquette measures, including hand hygiene, the use of disposable tissues to cover the mouth and nose, the use of masks as well as spatial separation recommendations for patients with symptoms of respiratory infection(27, 177).

The material required for respiratory hygiene / cough etiquette should be available at all points of care and in the waiting room for patients. Tissues and no-touch waste receptacles (foot pedal–operated lid or open waste basket) must be available, dispensers must be installed for boxes of masks and masks provided. A handwashing station that is visible and easily accessible to visitors must also be provided in the waiting room(10, 52, 143, 144, 150).

Posting visual alerts at the entrance to emergency departments is an effective way of asking patients and visitors to report any symptoms of respiratory infection to health care staff and immediately observe respiratory hygiene / cough etiquette and hand hygiene(140, 168, 175, 177). Bulletin boards can be installed to provide information on IPC or the epidemiological situation of certain infectious diseases (e.g., measles). The necessary tools (e.g., bulletin boards, display frames, sign displays) should be provided in strategic locations in the emergency department(178).

Spatial separation of at least two metres should be maintained between people who have a fever and cough and others who do not, unless there is a physical barrier in the waiting room(179, 180). Reinforcement is necessary to ensure these measures are rigorously applied during the flu season (mainly from November to April)(180).

Recommendations:

20 Ensure patients, visitors and staff observe respiratory hygiene / cough etiquette. **(1A)**

57 Provide ABHR dispensers, masks and tissues as well as no-touch waste receptacles in the common waiting room and in the designated room for respiratory hygiene / cough etiquette. **(1B)**

59 Group patients with similar clinical syndromes together in the waiting room or in a designated area of the waiting room. **(1C)**

60 If the waiting room is not separated by a physical barrier, a distance of two metres should be maintained between patients with a clinical picture of a transmissible respiratory infection and other patients in the common waiting room. **(1C)**

12 Provide spaces in each area and near each bed to post information about IPC (e.g., isolation, hand hygiene, respiratory hygiene / cough etiquette). **(1A)**

4.12.3 Use of Personal Protective Equipment as Part of Routine Practices

Wearing PPE is a part of routine IPC practices. PPE includes the following items: gloves, mask, gown, eye protection, visor and N-95 respirator. In the emergency department, the risk of transmission of infectious diseases among staff is significant, for health care teams have close, frequent contact with patients with undiagnosed infections, hence the need for PPE(142, 181).

Authors have shown that PPE use is suboptimal in the emergency department, mainly due to inadequate knowledge of the subject(182, 183). After the influenza A(H1N1) pandemic, a study was conducted in 14 Canadian hospitals and the results showed that health care workers working in an intensive care unit or a designated influenza ward (78% and 67% respectively) were more compliant with wearing an N-95 respirator than those working in an emergency department (45%, $p < 0.001$)(184).

To ensure that routine practices are applied at all times and that additional precautions are implemented when necessary, PPE should, at a minimum, be available and accessible at all points of care. Space for storing PPE should be provided near its point of use (1, 143, 150, 185)(95, 184).

Reid et al. report that Canadian pediatric emergency physicians would be more likely to use PPE if patients were clearly identified as potentially contagious prior to assessment, equipment was accessible and PPE use was made a priority in their emergency department. Twenty-two percent of participants (n = 123) reported that they had never received PPE training, while 32% said they had not received training in the previous two years. The main changes proposed by the authors to improve compliance with PPE among emergency physicians are the early identification of patients requiring PPE use, convenient access to PPE and improved education on PPE use(182).

The CDC and Health Canada recommend using PPE when necessary. During routine practices, in particular, gloves should be used to prevent contact with body fluids and not in place of hand hygiene. Wearing a mask and eye protection is recommended when performing splash- or aerosol-generating procedures (blood, body fluids, secretions, excretions). A long-sleeved gown should be worn to protect the forearms and clothing of health care staff from splashes and spills of body substances. If there is no physical barrier when the rapid assessment is done, the staff concerned should use PPE in the presence of a suspected, probable or confirmed case of SRI. If there is a physical barrier, a surgical mask, eye protection in accordance with routine practices, gloves and a long-sleeved gown are not required. Health care staff should wear a mask when examining and providing care to a patient with signs and symptoms of respiratory infection(10, 112).

Recommendations:

48 Use personal protective equipment (e.g., gloves, mask, eye protection, gown) in accordance with routine practices and additional precautions. **(1A)**

78 Ensure there is sufficient space near the point of care of each bed space to install mobile units that contain dedicated equipment and PPE. **(1B)**

79 Provide storage spaces for mobile units that contain dedicated equipment and PPE. **(1B)**

80 Ensure there is sufficient space in each bed space to install receptacles that are large enough for the disposal of soiled PPE. **(1B)**

4.12.4 SHARPS SAFETY

Routine practices stipulate that sharps be disposed of in puncture-resistant containers at points of care in the emergency department(51, 64, 138, 150, 186).

Overfilling of these containers poses a risk for health care staff who can injure themselves when placing an object in them(186). Procedures for the management, placement and replacement of these containers must therefore be clearly defined. The implementation of a protocol for replacing sharps containers resulted in a 53% decline in needlestick injuries in Virginia(187).

Recommendation:

45 Make puncture-resistant containers available and accessible at all points of care for sharps disposal and ensure they are replaced once filled to their safe maximum capacity. **(1A)**

4.13 Additional Precautions

Annual outbreaks of influenza and viral gastroenteritis highlight the ease and rapidity with which certain viruses are introduced and transmitted in health care settings, in particular for geriatric or pediatric patients(73, 142). The risk of acquiring an infection following a visit to the emergency department is higher in the elderly (OR = 3.9, 95% confidence interval: 1.4–10.8) in contrast to what is observed in the pediatric population; a visit to a pediatric emergency department is not associated with an increased risk of infection above the risk in the community(48, 49).

Additional precautions must be implemented rapidly based on the patient's clinical picture. The type of measures is determined by the nature of the infection (microorganism transmitted by the contact, droplet or airborne route), local epidemiology, and without waiting for laboratory results confirming a diagnosis(13, 27, 95, 150). Whenever a patient presents with signs and symptoms of a transmissible infection or a history of contact with infected cases, additional precautions should be initiated without delay(47, 106).

Additional precautions may include placing a patient in a airborne infection isolation room or protective environment rooms, as appropriate(73, 176). The CDC recommends placing a patient who presents to the emergency department with fever and cough (especially if the patient has been symptomatic for two weeks) in an isolation room or that he wear a mask to protect other patients and health care workers(70, 73).

The experience with SARS in Vancouver proved that the rapid implementation of additional precautions for cases with a clinical picture of respiratory infection (whose source was, in this particular case, unknown) is an effective control measure. Indeed, fifteen minutes after the first SARS case arrived in the emergency department, the necessary additional precautions were instituted, including isolation of the patient in a private room in the emergency department. The patient was placed in a negative pressure isolation room two and a half hours after arriving. Mathematical models for the SARS virus have stressed the importance of source case management in predicting the likelihood of an epidemic(153).

Cases of nosocomial tuberculosis transmission have been reported in hospitals, including the emergency department of a Québec hospital centre in 2011. These outbreaks have been associated with delays diagnosis and treatment or with suboptimal health care facility design(59, 71, 77).

Greenaway showed that 45% of patients admitted for tuberculosis in Canada were not initially diagnosed with this infection, mainly in health care facilities with low tuberculosis admission rates and where there may be a lack of knowledge of the disease(188). Tuberculosis is often unsuspected and isolation measures are sometimes not used in the emergency department(189).

The risk of tuberculosis transmission is partly based on the number of patients with tuberculosis admitted annually and the practice of high-risk activities, such as procedures that stimulate coughing(37-39, 59). The CDC suggests that emergency departments develop protocols for the early identification and isolation of potential tuberculosis patients and that protocols be based on the prevalence and characteristics of tuberculosis in the population served by a facility(51, 70, 190).

It is recommended that any patient with a clinical presentation that suggests the possibility of airborne transmission (e.g., tuberculosis, measles, chickenpox, SRI) should be placed in an airborne isolation room(59, 73). Delays in the steps leading to the isolation of a case can have significant consequences. Tipple et al. reported that before being placed in respiratory isolation, a patient with tuberculosis was admitted to two general medical wards over a three-week period, exposing 261 patients and 784 staff members. Following this episode, five secondary tuberculosis cases were diagnosed three to six months after exposure(191). The CDC reported that a measles outbreak in California was caused by the delay in isolating the index patient who spent eight hours in the waiting room of an emergency department before being placed in isolation(56).

If such an airborne isolation room does not exist in the emergency department, but exists elsewhere in the hospital, the patient should be promptly transferred to this room. Arrangements can also be made to transfer the patient to another centre with the appropriate technical measures (however, there should be at least be one area available where respiratory isolation can be maintained until the patient is transferred)(59).

A patient who arrives in the emergency department with infectious diarrhea should immediately be placed on additional contact precautions, including handwashing with soap and water and environmental disinfection to minimize the risk of transmission of microorganisms such as norovirus and *C. difficile.* The necessary diagnostic tests should be done as quickly as possible(106). During an epidemic or if an outbreak is suspected, cohorting of patients with the same diagnosis in an area of the emergency department is recommended(73).

Additional droplet precautions may also be necessary for cases of infectious gastroenteritis. Noroviruses are transmitted by direct contact with an infected patient, indirect contact with the contaminated environment, by a shared vehicle and by droplets propelled into the air by the infected patient when vomiting. Measures such as early identification and isolation of patients with gastroenteritis of infectious origin (e.g., norovirus) in the emergency department (including affected health care team members) are also effective in containing outbreaks(81, 82, 102).

Some authors recommend that immunocompromised patients should be placed in a protective environment room in the emergency department to protect them from acquiring potentially infectious environmental microorganisms or pathogens potentially transmitted by other patients(51, 79, 192).

Recommendations:

18 Ensure routine practices and additional precautions are implemented when indicated and provide training and documentation on these measures. **(1A)**

53 Upon arrival, immediately assess patients for fever, cough, skin rash, diarrhea, vomiting or any other symptoms that suggest a clinical picture of infection in order to promptly implement appropriate additional precautions. If a patient has these symptoms, immediately collect further information, such as history of travel and infectious contact. **(1A)**

52 Establish a system to rapidly direct patients to the appropriate area of the emergency department based on their presumed infectious status (e.g., airborne infection isolation room, designated waiting room, etc.). If an airborne infection is suspected (e.g., tuberculosis, chickenpox, measles, SRI), promptly direct the patient to an airborne infection isolation room in the emergency department or to a unit where this type of room is available. **(1A)**

4.14 Invasive Procedures in the Emergency Department

Care of some patients in the emergency department involves invasive procedures such as central venous catheter insertion and endotracheal intubation. Central venous catheters are a major cause of bacteremia. Guidelines to prevent these infections have been published and SHEA recommends measuring adherence to catheter insertion procedures in the emergency department(193, 194). The use of a catheter insertion checklist at the time of catheter insertion combined with appropriate education are effective measures in the emergency department(195).

The application of a set of best practices is recommended in all departments, including intensive care and the emergency department. It is sometimes difficult to ensure strict adherence to aseptic technique in the emergency department due to the need for rapid intervention in some cases. If adherence to aseptic technique cannot be ensured, the CDC and the Canadian Patient Safety Institute (CPSI) recommend replacing catheters as soon as possible, i.e., within 48 hours(194, 196).

Endotracheal intubation and mechanical ventilation are procedures associated with a risk of complications. Ventilator-associated pneumonia (VAP) is an example of a nosocomial infection that can occur 48 hours or more after intubation. The overall mortality rate associated with VAP ranges from 24 to 76%. Guidelines to prevent these infections have been established to improve patient outcomes and reduce the health care costs associated with complications(197-199).

The incidence of VAP associated with a visit to the emergency department is unknown, but intubation in the emergency department and length of stay in the emergency department are risk factors associated with the development of VAP. Grap et al. recommend that best practices used to reduce the risk of VAP in other hospital units (e.g., elevation of the head of the bed to 30-45 degrees, antiseptic application to the oral cavity, etc.) should be implemented in the emergency department before transporting the patient to a patient care unit(200).

In its set of best practices or “care bundle”, the CPSI recommends utilizing endotracheal tubes with subglottic drainage in all patients intubated in the emergency department, for these patients may be intubated for longer periods(199).

Recommendation:

85 Implement the necessary best practices to prevent healthcare-associated infections when performing invasive procedures. **(1C)**

4.15 IPC Training

Staff training and education is crucial to improving compliance with IPC measures in the emergency department(47, 174, 182, 195, 201, 202). Continuing education improves the staff's ability to identify patients with infectious symptoms during triage and the rapidity with which the required prevention and control measures are implemented. It is recommended that the emphasis should be placed on educating health care teams about the application of routine practices in the emergency department, in particular adherence to hand hygiene(51).

Training in the emergency department should also be accompanied by process quality assessment activities and the provision of feedback on the results of these assessments(203).

Recommendation:

23 Hold continuing education activities in IPC for emergency department staff (health care and support teams). **(1A)**

4.16 Emergency Department Overcrowding

Emergency department overcrowding is attributed to many factors, including the lack of availability of inpatient beds(204, 205). This undesirable situation increases patient anxiety, wait times, the workload of health care personnel and the risk of transmission of healthcare-associated infections among patients(205-210). In the Aucoin report, patient proximity in the emergency department was identified as one of the factors associated with the increase in healthcare-associated infections(147). Constant efforts must be made to prevent overcrowding and reduce wait times in the emergency department(73).

The emergence of SARS in 2003 highlighted the danger of emergency department overcrowding, since the presence of a single unidentified contagious patient in a crowded emergency department in Toronto proved to be the source of an outbreak(211, 212). A high bed occupancy rate increases proximity, complicates or precludes grouping sick patients together (cohorting) and promotes the transmission of pathogens such as norovirus and MRSA(82).

Overcrowding of patient care units is associated with the development of outbreaks and a higher risk of healthcare-associated infections(28, 30, 53, 83, 168, 213). The main factors involved are poor adherence to routine practices (mainly hand hygiene), increased patient and staff movement between patient care units, reduced cohorting capabilities and maximum occupancy of isolation rooms. The high occupancy rate of emergency department beds and rapid patient throughput in examination and treatment rooms also make cleaning these rooms more complicated and sometimes impossible(51).

Rapid diagnostic tests that are specific and sensitive for infectious diseases should also be available seven days a week in the emergency department. Obtaining rapid results within a few hours for the influenza virus can significantly reduce emergency department overcrowding(52).

The Canadian Association of Emergency Physicians recommends that all admitted patients should be transferred out of the emergency department to an appropriate patient care unit within two hours of admission(99, 204, 214-216). When SARS arose, one of the measures employed to limit the transmission of the virus was the removal of hallway beds(41, 87). Facilities must therefore develop a full capacity protocol and ensure it is applied if necessary. Measures to relieve congestion in the emergency department must be applied at all times(1, 204, 217).

Recommendation:

30 Apply measures to limit overflow in the emergency department bed area. Do not board admitted patients in emergency department beds. **(1A)**

4.17 Preventing Contamination of Environmental Surfaces

The environment, surfaces and finishes play a role in the transmission of some pathogens(92, 161). A study in Ohio found that 42% of privacy curtains were contaminated with VRE, 22% with MRSA, and 4% with *C. difficile.* The CINQ identified privacy curtains as a potential source for the spread of pathogenic microorganisms, for they are touched very frequently by health care providers and patients. In some settings, they are cleaned or changed infrequently, and health care workers and patients who touch them do not necessarily wash their hands before (or even after) touching them(218-220).

Furthermore, curtains greatly limit privacy. The *Guide de gestion de l'urgence* recommends doing away with curtains as a means of separating beds and using rigid, fixed partitions instead(87, 221).

Norovirus can survive for up to 28 days in the environment at room temperature(81, 222). Dalling et al. reported that of more than 200 swabs taken from curtains, carpets, commodes, furnishings and various surfaces within four feet of the patient during an outbreak of norovirus, 36% of specimens were positive(223). Other studies have shown contamination of bed rails, blood pressure cuffs, television remotes, bedside tables, call buttons and toilet seats(89, 91, 224, 225).

A number of agencies recommend using smooth, nonporous surfaces and floor coverings or materials with few joints in order to facilitate maintenance and reduce environmental contamination and the growth of microorganisms(3, 13, 226, 227).

Recommendations:

71 Do not use curtains to separate beds; instead use rigid, fixed, easily cleaned partitions. **(1B)**

83 Do not use curtains to separate trauma and resuscitation beds. **(1B)**

9 Use surface materials that are easy to clean and resistant to the detergents and disinfectants used. **(1A)**

4.18 Cleaning and Disinfection of Equipment and the Environment

Cleaning the hospital environment is a fundamental component of IPC. The Association for Professionals in Infection Control and Epidemiology (APIC) and the CDC recommend that spills should be cleaned up promptly and the surface decontaminated in accordance with recommended cleaning and disinfection procedures(64, 71, 143). Pathogenic microorganisms such as MRSA,

C. difficile and VRE have been found on various surfaces in the emergency department(185, 225). The incidence of healthcare-associated infections can be minimized by the proper use of detergents and disinfectants and the proper maintenance of medical equipment(64).

In Québec, health care facilities must determine and assign responsibilities for cleaning and disinfecting all the equipment and material used in patient care as well as all the surfaces patients may have direct or indirect contact with. Cleaning and disinfection must be performed according to a clearly defined schedule to ensure proper sanitary maintenance and prevent the transmission of infections(228).

Compliance with cleaning protocols is vital to limit the accumulation of pathogenic microorganisms in the environment(89). Policies and procedures must be established for the routine and thorough cleaning and disinfection of environmental surfaces in all areas of the emergency department(143).

The frequency of contact with surfaces varies depending on the surface. Some are touched more frequently by health care staff (“high touch” surfaces) and contribute more significantly to risk in the chain of transmission; others are touched less frequently and are called “low touch”(8). Appropriate cleaning and disinfection practices must be established for high-touch surfaces (e.g., examination tables, patient chairs, doorknobs, telephones, computer keyboards, light switches, bed rails, inside and outside surfaces of toilets). Guides to cleaning and disinfection methods for health care facilities are available(8, 64, 143).

In addition to the frequency of contact with surfaces, two other aspects must be assessed to determine cleaning and disinfection needs in the emergency department: the functional activities in the different areas and patient characteristics. These three aspects influence the risk of transmission of microorganisms from the environment(8). Cleaning and disinfection guidelines produced by the MSSS describing the procedures to follow are available on the MSSS Web site at the address www.msss.gouv.qc.ca in the section "Sujets" under "Problèmes de santé", heading "Infections nosocomiales", subheading "Hygiène et salubrité" [available in French only].

The important role of housekeeping services must be recognized by administrators and the various stakeholders in health care facilities(8). Insufficient housekeeping resources have been associated with outbreaks of healthcare-associated infections, hence the importance of maintaining quality service at all times(229). In Québec, in 2010, most emergency departments that completed a questionnaire on IPC practices in emergency departments reported having designated housekeeping personnel (76.2%). However, 54% of study respondents revealed that resources were inadequate(75).

Regular audits on the application of cleaning and decontamination protocols are recommended(88, 89, 143). Educational interventions to improve cleaning practices are recognized as an effective way to reduce contamination of environmental surfaces with *C. difficile* and VRE(185, 225, 230).

Surfaces for which the responsibility for cleaning and disinfection has not been assigned are referred to as “grey areas”. The MSSS recommends a systematic approach to standardizing and upgrading cleaning and disinfection practices for environmental surfaces. One of the means recommended is to monitor the local development of procedures used to assign responsibility for grey areas to ensure that all equipment and surfaces are properly cleaned and disinfected. A person responsible for the management of grey areas must be designated and must ensure that an inventory of all equipment and material used in patient care as well as all surfaces that require cleaning and disinfection is made and kept up to date. Furthermore, a cleaning log must be used in order to ensure that cleaning and disinfection procedures are performed by the designated departments(228). The MSSS has

developed specific tools for the emergency department and has identified a number of grey areas in the emergency department (e.g., supplies cart, defibrillator, computer)(11).

Recommendations:

38 Ensure that cleaning and disinfection guidelines are followed at all times (24/24, 7/7). **(1C)**

40 Adjust cleaning and disinfection protocols depending on:

- the pathogens and clinical syndromes involved; **(1B)**
- the frequency of contact (high touch and low touch); **(1C)**
- the volume of use and current epidemiology. **(1B)**

39 Develop and apply cleaning and disinfection protocols for environmental surfaces and patient care equipment. **(1B)**

41 Work toward eliminating grey areas in the emergency department. Clearly define responsibility for the maintenance of all equipment. **(1C)**

42 Use a log to record the cleaning and disinfection procedures performed for equipment and areas. **(1C)**

68 Cleaning and disinfection must always be performed rapidly following discharge of a patient known to be a carrier of a transmissible pathogen (e.g., MRSA, VRE, *C. difficile*, norovirus, influenza, etc.) or who has a similar clinical syndrome. **(1B)**

4.19 Maintenance of Shared Equipment

It has been shown that shared equipment can result in the transmission of pathogens. A study conducted in an emergency department in California reported that of the 164 ultrasound probes sampled, 67% were found to be contaminated, mainly with skin flora bacteria(231). Albert et al. reported microbial contamination in 63% of 226 samples collected from reusable electrocardiographic lead wires; contamination was higher in the emergency department than in intensive care(232). An outbreak of methicillin-susceptible *S. aureus* in neonates has been linked to the use of contaminated ultrasound gel(231, 233). In addition to lead wires, various studies have reported the contamination of shared equipment, in particular scissors and stethoscopes, by various pathogenic microorganisms (e.g., MRSA, *P. aeruginosa*, *Enterococcus faecalis*, *Escherichia coli*)(234-237).

Shared equipment should be properly cleaned and disinfected after each use. Special care must be taken after use with patients colonized by multi-resistant microorganisms (e.g., VRE, MRSA)(71, 231).

Barrier protection (e.g., sheet, paper) of certain surfaces that may be contaminated with body fluids and that are frequently touched by the gloved hands of staff during the delivery of patient care (e.g., examination tables) is recommended. After use, coverings should be removed and discarded or sent to the laundry by health care staff while they are still gloved. The surface should be covered with clean materials before the next patient encounter(64, 150, 238). The examination table should be cleaned regularly, based on its frequency of use and function, and cleaned immediately when soiled with blood or body fluids(71, 238, 239). The examination table should be cleaned at least daily(238).

Recommendations:

69 Cover the examination table with clean paper or a clean sheet for each patient and clean surfaces that have been in contact with the patient immediately after they leave. Ensure the table is routinely cleaned on a daily basis and adjust the frequency of cleaning depending on frequency of use and type of treatment. **(1B)**

43 Disinfect objects used for more than one patient (e.g., stethoscopes, scissors, blood pressure equipment) between each use. **(1A)**

4.20 Human Waste Management

Human waste (e.g., stool, vomit, urine) management is often complex in the emergency department given the health care context and the high turnover, diversity and vulnerability of patients. In particular, stool is a reservoir for commensal bacteria from the digestive tract (e.g., *E. coli*, *Klebsiella pneumoniae*, enterococci, etc.), some of which can be resistant to antibiotics. It has been shown that strict adherence to routine hygiene measures is vital for preventing the transmission of microorganisms among patients(240).

In 2009, AETMIS conducted a comparative analysis of bedpan processing equipment and recommended assigning responsibility for human waste management to administrators and staff with the collaboration of the IPC team(241).

In its report, AETMIS pointed out that the two pieces of equipment used to process bedpans, bedpan washers and macerators, each had their advantages and disadvantages. The study concluded that "any decision concerning infection prevention must be based on eliminating the source of risk. This means reducing handling, transport and processing times for soiled materials and equipment. Moreover, recommending a single method for managing biological waste or processing bedpans seems inappropriate. Indeed, a number of parameters come into play when choosing a method, in particular bedpan requirements, the risks of infection and outbreak, staff availability, the possibility of providing the required infrastructure and budgets. Taking the data presented in this brief into consideration, each health care facility must define its needs and make an informed and ecological choice" [Translated from French].

The CIPIN recommends creating safe routes for transporting clean and soiled equipment, materials and supplies and considering the introduction of separate routes and traffic controls to block the movement of users and materials in certain areas with a high contamination risk(97).

Recommendation:

47 Develop and apply a protocol for safe human waste and body fluids management. **(1C)**

4.21 Immunization of Emergency Department Personnel and Management of Personnel with Infectious Signs and Symptoms

The CDC recommends annual influenza vaccination for health care teams(27). An additional vaccination program for other pathogens (e.g., measles, mumps, German measles, chickenpox, hepatitis B, whooping cough) should be implemented in accordance with current

recommendations(150, 242, 243). Low immunization rates among emergency department personnel can contribute to the transmission of pathogens, such as influenza and measles(244).

One study revealed that during the 1999-2000 flu season, only 37% of staff in four emergency departments in Ontario were vaccinated against influenza. The study also showed that older health care workers and those with chronic medical conditions were more likely to accept vaccination. Furthermore, health care workers believed that the risk of infectious disease transmission from patients to health care workers was greater than the risk of transmission from health care workers to patients(245).

In March 2009, a case of measles infected five members of emergency department staff in a hospital in Pennsylvania in the United States. Of 168 potentially exposed employees, 72 (43%) did not have immunity to measles(246).

Thomas et al. showed that health care worker vaccination rates in a long-term care facility increased from 8 to 46% when an educational intervention preceded a vaccination fair(247). Strategies to optimize vaccination rates among emergency department personnel are suggested by some authors, in particular to improve communication surrounding emergency department personnel's beliefs about infectious risk and the potential benefits of vaccination(244, 245).

Some recommendations highlight the importance of developing self-exclusion from work policies for potentially contagious employees(52, 81, 150, 248). The CDC recommends that health care professionals who have a respiratory infection avoid all direct contact with patients, especially high-risk patients(95). The CINQ's scientific advisories on IPC measures in the event of an outbreak of viral infectious gastroenteritis (norovirus) and seasonal influenza contain a series of recommendations on how to manage staff who have an infectious disease(82, 180).

Recommendations:

36 Health care staff who have symptoms of a transmissible infection should stay at home until the period of contagiousness is over; in exceptional cases, if there is an impact on care and services (e.g., disruption of services), provide for a procedure that allows sick staff to be assigned to support activities. **(1C)**

37 Implement an immunization program for staff in the process of being hired and those already employed based on the risks associated with their work. **(1A)**

4.22 Construction or Renovation of an Emergency Department

IPC teams have a role to play in designing plans and specifications for the renovation or construction of health care facilities(2, 65, 72, 80). Their involvement is intended to ensure the architectural design will reduce the risks of transmission of healthcare-associated infections and promote optimal work organization(144).

Guidelines on this subject have been published by the FGI. The CDC also supports the involvement of IPC teams at the earliest planning and design stages to contribute to discussions, for instance, on budget, space constraints, including storage space for housekeeping equipment, ventilation, hand hygiene infrastructure, selection of appropriate finishes and current regulations(95, 144).

Moreover, their involvement is also essential to establish specific measures to implement to avoid patient exposure to certain pathogens, such as *Aspergillus* spp. during construction and renovation work(249).

Recommendation:

32 When renovating or constructing an emergency department, involve the IPC team in the project at the planning and design stage. **(1A)**

4.23 IPC Committee in the Emergency Department

Shook recommended implementing an IPC program in the emergency department, taking patient characteristics and the specific IPC challenges of this department into account(51). As one of the strategies that support the implementation of this type of program, some health care facilities in Québec established an IPC committee in the emergency department. In a study conducted in 2010, 19% of participating emergency departments had a designated member of emergency department staff for IPC for this sector (12/63), while 5% had an IPC subcommittee (3/63). Made up of IPC nurses, emergency department nurses, emergency physicians and microbiologists/infectious disease specialists, these interdisciplinary subcommittees reported to the hospital's IPC committee(75).

Collins reported that establishing an IPC committee in the emergency department is an effective intervention that promotes the dissemination of IPC updates expressly adapted for emergency department staff(146).

Recommendation:

29 Establish an IPC subcommittee in the emergency department. **(2)**

4.24 Surveillance of Emerging Infectious Diseases, Healthcare-Associated Infections and the Application of IPC Measures in the Emergency Department

Surveillance is an essential component of an infection prevention program. In Québec, a number of nosocomial infection surveillance programs monitor nosocomial infection rates in health care settings. Bacteremia surveillance data have shown that since the program was started in 2007, 205 of the 1942 bloodstream infections acquired by ambulatory patients were acquired in the emergency department (10.6%) (retrieved from the Surveillance provinciale des infections nosocomiales [Provincial surveillance of healthcare-associated infections] portal on August 3, 2012).

Surveillance of nosocomial infection rates in the emergency department is challenging, for patient visits are often brief and the assessment and treatment of subsequent infections may take place in different health care centres(71, 143). The CDC nonetheless recommends identifying performance indicators, measuring the transmission of infectious diseases and providing feedback to staff(95). Some infections develop after patients have been discharged, such as urinary tract infections, surgical site infections or *C. difficile* diarrhea. Emergency department staff should be informed about current surveillance programs and report these infections to IPC professionals(250-253).

In Québec, as prescribed by regulation under the *Public Health Act*, there is a list of diseases that must be reported(254). To be included in the list, the intoxication, infection or disease must be capable of causing an epidemic if nothing is done to combat it, must be recognized as constituting a significant threat to health, as requiring vigilance on the part of public health authorities or an epidemiological investigation and preventable by the intervention of public health authorities or other authorities. Any physician who diagnoses an infection included in the list or who observes the presence of clinical manifestations characteristic of any of these infections in a living or deceased person is required to make a report to his Direction régionale de santé publique [Regional public health authority] within 48 hours(255). The PHAC indicates that emergency physicians are required to report any disease or health condition that may give rise to a public health emergency situation(256).

Other surveillance programs of epidemiological and public health significance have been developed in Québec, in particular for the surveillance of ILI cases as part of the surveillance of influenza and cases of emerging severe respiratory illnesses(123, 257). This requires the collaboration of health care personnel in emergency departments. Moreover, at the beginning of the viral gastroenteritis season, increased vigilance and surveillance are recommended at the triage stage in the emergency department to rapidly detect all suspect cases. Vigilance and surveillance are especially important when a Direction régionale de santé publique reports outbreaks in its region(82).

Bénet et al. report that during the influenza A(H1N1) pandemic, surveillance of ILI cases in two emergency departments in France revealed a high linear correlation between the number of visits related to ILI to pediatric emergency departments and the number of visits related to ILI in adults ($R = 0.82$, $p < 0.001$). An interval of two days was observed between children's and adults' visits for a clinical picture of ILI; this could be explained by the incubation period of the influenza virus. The authors conclude that the surveillance of infectious diseases in the emergency department can be helpful in organizing the department during seasonal flu outbreaks and future pandemics(258).

Process evaluation activities should also be carried out regularly to measure compliance with hand hygiene and cleaning and disinfection protocols and to record the number of incidents and accidents where health care teams are exposed to body fluids(143). Similar recommendations were made when identifying the basic conditions required to prevent healthcare-associated infections, specifically the transmission of VRE(259).

Recommendations:

24 Develop and implement an active surveillance system for infectious diseases of epidemiological significance (e.g., influenza-like illness [influenza, SARS, SRI], febrile rash illness [measles], infectious gastroenteritis, other outbreaks of diseases in the community of interest to public health). **(1B)**

25 Participate in mandatory public health surveillance programs (e.g., notifiable diseases, SRI, influenza). **(1B)**

26 Participate in local nosocomial infection surveillance programs by notifying the IPC team when patients present to the emergency department with healthcare-associated infections such as surgical site infections, gastroenteritis, urinary tract infections, etc. **(1B)**

27 Monitor IPC procedures in the emergency department (e.g., audit adherence to routine practices, additional precautions and cleaning and disinfection protocols). **(1B)**

28 Ensure surveillance results are interpreted and distributed to staff and administrators. **(1B)**

4.25 Contingency Plan in the Emergency Department

The emergence of SARS and the influenza A(H1N1) pandemic highlighted the importance of developing and implementing a contingency plan in the emergency department(260, 261). The Aucoin report explains that a patient with this type of disease usually goes to the hospital's emergency department. If the latter is not prepared and equipped to prevent the transmission of a new infection such as SARS, it may be transmitted to other patients, staff and visitors in the hospital(147).

However, it has been reported that emergency departments are not generally prepared to respond to emerging biological threats and bioterrorism(76, 262). A response plan for infectious disease emergencies should be included in every emergency department's contingency plan(71, 262, 263). Annual disaster preparedness drills should incorporate various scenarios to test and refine readiness plans and allow staff to become familiar with the measures to be applied. These plans should be developed in partnership with the emergency response committee and local public health agencies (262, 263).

Clear guidelines on professionals' different roles and responsibilities in a crisis situation (including outbreaks), triage methods, isolation, post-exposure management and methods of communication to be implemented must be available for various scenarios(260, 261, 264). During a public health infectious disease emergency, extraordinary measures may be taken, including the restriction of visitors, increasing isolation capacity and increased use of PPE(260).

Recommendation:

31 Develop a contingency plan for epidemics, pandemics and bioterrorism. **(1A)**

4.26 Communication of Information Concerning Infectious Cases

Communication is an important component of IPC both within and between facilities, especially during an outbreak or in the presence of multi-resistant pathogens. Alert and communication mechanisms are essential to allow staff to exercise greater vigilance and implement the necessary additional precautions(82). Communication methods must respect confidentiality and the codes of ethics of various professional orders(265, 266).

Depending on the situation, the facility must report the infectious risk to public health authorities and vice versa. The SARS epidemic highlighted the importance of establishing effective communication networks. Approximately 2000 travellers arrive in Vancouver on direct flights from Hong Kong and China every day. This city is therefore a potential gateway to North America for the introduction of emerging pathogens from Asia. Because of this perceived risk, public health authorities in British Columbia established an electronic distribution system to disseminate communicable disease bulletins. This established communication network was used even before the first case of SARS arrived in the emergency department to issue an alert requesting enhanced vigilance for ILI in returning travellers from China or Hong Kong(153).

The CDC reports that delayed notification of public health authorities by emergency department staff after the arrival of a refugee infected with measles from Myanmar contributed to an outbreak(56).

The measles epidemic in Québec in 2011 led to the development of an active surveillance and case reporting system. Numerous public information messages were disseminated and a mass immunization campaign was undertaken(267, 268). At the beginning of the outbreak in the Capitale-Nationale health and social services region, seven people acquired the infection in the emergency department. These people were patients consulting in the emergency department for another health problem, people accompanying them or members of staff of the facility (two staff members in one health care facility were confirmed to have active measles following contact with a non-isolated case). Communication links were rapidly established between IPC teams and regional public health authorities: when a suspect case was reported, a discussion was quickly held over the telephone to gain an overview of the situation and determine what types of interventions should be implemented. This ensured that the interventions undertaken in health care settings and those at the community level were harmonized, thus helping to limit the transmission of the infection in health care settings and end the outbreak affecting the region (personal communication, Dr. Jasmin Villeneuve).

Recommendations:

33 Communicate the relevant information regarding any patient with a clinical picture of a transmissible infection to any other departments concerned (e.g., additional precautions to be applied). **(1C)**

34 Ensure that medical and nursing staff in the emergency department are informed in real time about outbreaks of infectious diseases in their community. **(1A)**

4.27 Information and Electronic Technology

Emergency department triage software offers significant benefits: optimization of work organization and communication between health care providers, easy access to triage notes, real-time access to clinical data and more efficient directing of patients. Furthermore, dynamic triage management provides a performance assessment tool and facilitates decision making(1, 269).

Using technology tools such as computer systems, email alerts, low frequency telephones and television screens facilitates infectious disease surveillance, improves collaboration between public health authorities and emergency departments and allows outbreaks to be detected earlier (65, 92, 270, 271). In a study conducted in Québec in 2010, 82.5% (52/63) of participating emergency departments reported using a computer alert to identify MRSA patients(75).

Revere et al. stressed the importance of improving the effectiveness of the systems used to communicate messages between emergency departments and public health agencies during infectious disease emergencies(272). In their literature review, they found that very few systems were used in emergency departments and that the tools used varied widely: email (64%), fax (36%), cell phone (36%), coder (28%), text messaging (16%), social media (4%). In Ontario, a pilot project involving the implementation of an integrated surveillance system in emergency departments in collaboration with public health authorities showed that information technology was useful in enhancing outbreak detection (e.g., seasonal influenza, foodborne outbreaks), early response and recovery. For example, this type of system provides real-time information to public health personnel about outpatient visits and attack rates, facilitating rapid risk group assessment. It also provides front-line health care workers with information about circulating strains and unusual severity of illness(270).

Recommendation:

35 Use information technology to provide rapid access to data on a patient's infectious status (e.g., MRSA or VRE carrier) and to effectively communicate information of interest to public health (e.g., outbreak of an infectious disease in the community for a given region or country). **(1B)**

4.28 Pest Control (Insects, Rodents)

Insects and small mammals are considered pests and are potential vectors for pathogenic microorganisms in health care settings(64). For example, cockroaches may carry microorganisms such as *E. coli*, *Klebsiella* spp., *Acinetobacter baumanni*, *P. aeruginosa* or fungi on their external surfaces or in their gastrointestinal tract. A cockroach infestation caused by improper closure of doors and windows was reported at the University of Geneva Hospital Centre in 2009. The implementation of clear guidelines on the importance of keeping doors and windows closed halted the infestation(273). An outbreak of nosocomial infection due to *K. pneumoniae* associated with cockroaches has also been documented in South Africa(274).

In addition to cockroaches, the presence of rats, mice, ants, silverfish, beetles, wasps and hornets have been documented as the reason behind pest control interventions in hospitals(275).

Bats have been discovered on some wards, namely, the general medical ward and the surgical ward of a hospital in Dundee, Scotland, and inside the walls of a hospital in North Carolina in the United States. The presence of this small mammal, known to be a vector for the rabies virus, meant that patients had to be moved to other hospitals and patient care temporarily suspended(275, 276). Bats have been reported at times in health care facilities in Québec.

The CDC recommends establishing a control program for insects and rodents, eliminating food sources and other conditions that attract pests, sealing windows, installing mosquito screens in windows and closing doors to the outside(64).

In Québec, HVAC systems are sometimes inadequate in hot weather and opening windows is the only option. The FGI recommends installing mosquito screens on windows and doors that are frequently left open(65). The emphasis should be placed on installing mosquito screens in good repair rather than on sealing or bolting windows.

Recommendation:

14 Take measures to prevent the intrusion of insects and other pests via the entrance to the ambulance garage, windows and doors (e.g., install mosquito screens on windows, keep doors closed). **(1B)**

5 Conclusion

The emergency department is one of the main gateways to Québec's hospital network. Patients may be carriers of transmissible pathogenic microorganisms, including antibiotic-resistant microorganisms. The emergency department may also see patients with emerging infectious diseases and is therefore a strategic place for managing the transmission of infections.

The high proportion of vulnerable patients, in particular immunocompromised patients and elderly persons, contributes to the risk of transmission of infections for emergency department staff and patients. Hospital overcrowding, delays in implementing additional precautions and patient proximity are additional factors.

By using a hierarchy of controls (engineering controls, administrative controls, and personal protective equipment), the risk of transmission of infections in the emergency department can be reduced. The implementation of IPC measures in the different areas of the emergency department is an effective approach.

Measures are recommended for implementation in key sectors, such as air quality and pressure, pressure-controlled rooms, single rooms and overflow beds, triage, waiting rooms, administrative support, routine practices and additional precautions, cleaning and disinfection of equipment and the environment, maintenance of shared equipment, immunization of personnel, surveillance of infectious diseases, communication concerning infectious cases, information and electronic technology and pest control in the emergency department.

IPC in emergency departments must be an organizational concern. Upgrading the existing infrastructure in Québec's emergency departments is a major challenge in terms of IPC.

References

1. Association québécoise d'établissements de santé et de services sociaux. Guide de gestion de l'urgence. MSSS; 2006 Sep.

2. CIPIN. Prévention et contrôle des infections nosocomiales. Principes généraux d'aménagement: centres hospitaliers de soins généraux et spécialisés (CHSGS), centres hospitaliers et instituts affiliés universitaires (CHU, CHAU, IU). 2009 Jun.

3. Corporation d'hébergement du Québec. Guide de planification immobilière - unité d'urgence (document de travail). 2009 Apr.

4. Ministère de la Santé et des Services sociaux du Québec (MSSS). Plan d'action sur la prévention et le contrôle des infections nosocomiales 2010-2015. 2011.

5. Public Health Agency of Canada. Routine Practices and Additional Precautions for Preventing the Transmission of Infection in Healthcare Settings. 2010 Sep 1.

6. The Expert Panel on Influenza and Personal Protective Respiratory Equipment. Influenza Transmission and the Role of Personal Protective Respiratory Equipment: An Assessment of the Evidence. Ottawa Council of Canadian Academies; 2007.

7. Prevention and Control of Influenza during a Pandemic for All Healthcare Settings. Public Health Agency of Canada. 2011 Sept. 1 URL: http://www.phac-aspc.gc.ca/cpip-pclcpi/annf/index-eng.php.

8. Groupe Hygiène et salubrité au regard de la lutte aux infections nosocomiales. Lignes directrices en hygiène et salubrité - analyse et concertation. 2006 May.

9. Comité sur les infections nosocomiales du Québec. Sélection des solutions hydro-alcooliques en milieux de soins. Institut national de santé publique du Québec; 2011 Jan 7.

10. Health Canada. Routine Practices and Additional Precautions for Preventing the Transmission of Infection in Healthcare Settings. 1999 Jul.

11. MSSS. Les zones grises: processus d'attribution des responsabilités. 2008.

12. MSSS. Les infections nosocomiales: Cadre de référence à l'intention des établissements de santé du Québec. 2006.

13. World Health Organization. Prevention of hospital-acquired infections - A practical guide. 2002.

14. Sydnor ER, Perl TM. Hospital Epidemiology and Infection Control in Acute-Care Settings. Clin Microbiol Rev 2011 Jan;24(1):141-73.

15. Mills JM, Harper J, Broomfield D, Templeton KE. Rapid testing for respiratory syncytial virus in a paediatric emergency department: benefits for infection control and bed management. J Hosp Infect 2011 Mar;77(3):248-51.

16. Fung CP, Hsieh TL, Tan KH, Loh CH, Wu JS, Li CC, et al. Rapid creation of a temporary isolation ward for patients with severe acute respiratory syndrome in Taiwan. Infect Control Hosp Epidemiol 2004 Dec;25(12):1026-32.

17. Chen YC, Huang LM, Chan CC, Su CP, Chang SC, Chang YY, et al. SARS in Hospital Emergency Room. Emerg Infect Dis 2004 May;10(5):782-8.

18. Chang WT, Kao CL, Chung MY, Chen SC, Lin SJ, Chiang WC, et al. SARS Exposure and Emergency Department Workers. Emerg Infect Dis 2004 Jun;10(6):1117-9.

19. Behrman AJ, Shofer FS. Tuberculosis Exposure and Control in an Urban Emergency Department. Ann Emerg Med 1998 Mar;31(3):370-5.

20. Sokolove PE, Mackey D, Wiles J, Lewis RJ. Exposure of emergency department personnel to tuberculosis: PPD testing during an epidemic in the community. Ann Emerg Med 1994 Sep;24(3):418-21.

21. Wicker S, Rabenau HF, Bickel M, Wolf T, Brodt R, Brandt C, et al. [Novel influenza H1N1/2009: virus transmission among health care worker]. Dtsch Med Wochenschr 2009 Nov;134(48):2443-6.

22. Kuster SP, Drews S, Green K, Blair J, Davis I, Downey J, et al. Epidemiology of influenza-associated hospitalization in adults, Toronto, 2007/8. Eur J Clin Microbiol Infect Dis 2010 Jul;29(7):835-43.

23. Lera CE, Worner NT, Sancosmed RM, Fabregas MA, Casquero CA, Cebrian RR. [Impact of the 2009 influenza A (H1N1) virus pandemic on the emergency department of a tertiary hospital]. An Pediatr (Barc) 2011 Mar 18.

24. Lera E, Worner NT, Sancosmed M, Fabregas A, Casquero A, Melendo S, et al. Clinical and epidemiological characteristics of patients with influenza A (H1N1) 2009 attended to at the emergency room of a children's hospital. Eur J Pediatr 2011 Mar;170(3):371-8.

25. Santos CD, Bristow RB, Vorenkamp JV. Which health care workers were most affected during the spring 2009 H1N1 pandemic? Disaster Med Public Health Prep 2010 Mar;4(1):47-54.

26. Patel JC, Mollitt DL, Pieper P, Tepas JJ, III. Nosocomial pneumonia in the pediatric trauma patient: a single center's experience. Crit Care Med 2000 Oct;28(10):3530-3.

27. Rothman RE, Irvin CB, Moran GJ, Sauer L, Bradshaw YS, Fry RB, Jr., et al. Respiratory Hygiene in the Emergency Department. J Emerg Nurs 2007 Apr;33(2):119-34.

28. Clements A, Halton K, Graves N, Pettitt A, Morton A, Looke D, et al. Overcrowding and understaffing in modern health-care systems: key determinants in meticillin-resistant Staphylococcus aureus transmission. Lancet Infect Dis 2008 Jul;8(7):427-34.

29. Humphreys H. Overcrowding, understaffing and infection in hospitals. Ir Med J 2006 Apr;99(4):102.

30. Borg MA. Bed occupancy and overcrowding as determinant factors in the incidence of MRSA infections within general ward settings. J Hosp Infect 2003 Aug;54(4):316-8.

31. Kaminski A, Kammler J, Wick M, Muhr G, Kutscha-Lissberg F. Transmission of methicillin-resistant Staphylococcus aureus among hospital staff in a German trauma centre: a problem without a current solution? J Bone Joint Surg Br 2007 May;89(5):642-5.

32. Kilbane BJ, Reynolds SL. Emergency department management of community-acquired methicillin-resistant Staphylococcus aureus. Pediatr Emerg Care 2008 Feb;24(2):109-14.

33. Patrozou E, Reid K, Jefferson J, Mermel LA. A cluster of community-acquired methicillin-resistant Staphylococcus aureus infections in hospital security guards. Infect Control Hosp Epidemiol 2009 Apr;30(4):386-8.

34. De Carli G, Puro V, Binkin NJ, Ippolito G. Risk of human immunodeficiency virus infection for emergency department workers. Italian Study Group on Occupational Risk of HIV Infection. J Emerg Med 1994 Nov;12(6):737-44.

35. Greco GM, Paparo R, Ventura R, Migliardi C, Tallone R, Moccia F. [Prevalence of patients with HIV infection in an emergency department]. Clin Ter 1995 Jan;146(1):75-8.

36. Marco CA, Rothman RE. HIV infection and complications in emergency medicine. Emerg Med Clin North Am 2008 May;26(2):367-ix.

37. Escombe AR, Huaroto L, Ticona E, Burgos M, Sanchez I, Carrasco L, et al. Tuberculosis transmission risk and infection control in a hospital emergency department in Lima, Peru. Int J Tuberc Lung Dis 2010 Sep;14(9):1120-6.

38. Long R, Zielinski M, Kunimoto D, Manfreda J. The emergency department is a determinant point of contact of tuberculosis patients prior to diagnosis. Int J Tuberc Lung Dis 2002 Apr;6(4):332-9.

39. Wetsteyn JC, de Rond WM, Schreuder MC, de Boer HE, van Binnendijk RS, Wolthers KC. [An outbreak of measles at an emergency room]. Ned Tijdschr Geneeskd 2008 Sep 13;152(37):2032-6.

40. Adams J. Measles patient ordered into isolation, but remains in the emergency department for 12 hours. ED manag 2008;20(11):121.

41. Borgundvaag B, Ovens H, Goldman B, Schull M, Rutledge T, Boutis K, et al. SARS outbreak in the Greater Toronto Area: the emergency department experience. CMAJ 2004 Nov 23;171(11):1342-4.

42. Dull SM, Brillman JC, Simpson SQ, Sklar DP. Hantavirus pulmonary syndrome: recognition and emergency department management. Ann Emerg Med 1994 Sep;24(3):530-6.

43. Drumm C, Bruner J, Minutillo A. Plague comes to New York: visitors from New Mexico test a big-city hospital's emergency preparedness. Am J Nurs 2004 Aug;104(8):61-4.

44. Smith SM. Imported Disease in Emergency Departments: An Undiscovered Country? J Travel Med 2006 Mar;13(2):73-7.

45. Swanson ER, Fosnocht DE. Anthrax threats: a report of two incidents from Salt Lake City. J Emerg Med 2000 Feb;18(2):229-32.

46. Vardy J, Mukherjee N, Dignon N. H5N1 influenza questionnaire: are Scottish emergency departments ready to isolate and treat a possible index case? Emerg Med J 2007 Apr;24(4):283-5.

47. Fusco FM, Schilling S, De IG, Brodt HR, Brouqui P, Maltezou HC, et al. Infection control management of patients with suspected highly infectious diseases in emergency departments: data from a survey in 41 facilities in 14 European countries. BMC Infect Dis 2012;12:27.

48. Quach C, McArthur M, McGeer A, Li L, Simor A, Dionne M, et al. Risk of infection following a visit to the emergency department: a cohort study. CMAJ 2012 Mar 6;184(4):E232-E239.

49. Quach C, Moore D, Ducharme F, Chalut D. Do pediatric emergency departments pose a risk of infection? BMC Pediatr 2011;11:2.

50. Quach C, McGeer A, Simor A. Emergency departments - when it's not just about waiting but also about sharing. 2010.

51. Shook JE. Infection control in the emergency department. Semin Pediatr Infect Dis 1995 Oct;6(4):265-72.

52. Comité de protection urgence pandémie influenza. Healthcare Worker Protection in the Emergency Department During Pandemic Influenza - A Position Paper. 2009 Oct 2.

53. Keegan AD. Hospital bed occupancy: more than queuing for a bed. Med J Aust 2010 Sep 6;193(5):291-3.

54. Gilligan P, Winder S, Singh I, Gupta V, Kelly PO, Hegarty D. The Boarders in the Emergency Department (BED) study. Emerg Med J 2008 May;25(5):265-9.

55. Hamel M, Zoutman D, O'Callaghan C. Exposure to hospital roommates as a risk factor for health care-associated infection. Am J Infect Control 2010 Apr;38(3):173-81.

56. Centers for Disease Control and Prevention. Measles Outbreak Associated with an Arriving Refugee - Los Angeles County, California, August–September 2011. MMWR 2012 Jun 1;1(61):385.

57. Schwartzman K, Menzies D. Tuberculosis: 11. Nosocomial Disease. CMAJ 1999 Nov. 16;161(10):1271-7.

58. Thorne CD, Khozin S, McDiarmid MA. Using the hierarchy of control technologies to improve healthcare facility infection control: lessons from severe acute respiratory syndrome. J Occup Environ Med 2004 Jul;46(7):613-22.

59. Public Health Agency of Canada. Canadian Tuberculosis Standards - 6th Edition. 2007.

60. Synthèse 2005-06 à 2009-10 p01-p13 Patients sur civière. Microsoft Excel, editor. 2010. Ref Type: Data File.

61. Comité sur la qualité de l'air intérieur. La qualité de l'air intérieur dans les établissements du réseau de la santé et des services sociaux. Corporation d'hébergement du Québec; 2005 Feb.

62. Comité sur la qualité de l'air intérieur. Guide de qualité de l'air intérieur dans les établissements du réseau de la santé et des services sociaux. Ministère de la Santé et des Services sociaux; 2011.

63. Special requirements for heating, ventilation and air-conditioning (HVAC) systems in health care facilities CSA z317.2-10 2010.

64. Centers for Disease Control and Prevention, HICPAC. Guidelines for Environmental Infection Control in Health-Care Facilities. Atlanta; 2003.

65. The Facility Guidelines Institute. Guidelines for Design and Construction of Health Care Facilities. 2010.

66. Summary of probable SARS cases with onset of illness from 1 November 2002 to 31 July 2003. World Health Organization 2004 April 21 URL: http://www.who.int/csr/sars/country/table2004_04_21/en/.

67. Campbell A. The SARS Commission Interim Report - SARS and Public Health in Ontario. Ontario; 2004 Apr 15.

68. Walker JT, Hoffman P, Bennett AM, Vos MC, Thomas M, Tomlinson N. Hospital and community acquired infection and the built environment--design and testing of infection control rooms. J Hosp Infect 2007 Jun;65 Suppl 2:43-9.

69. Comité ministériel sur les mesures de précaution contre le SARS. Orientations sur les mesures collectives et recommandations sur les mesures individuelles de prévention du SARS. MSSS; 2004 May.

70. Centers for Disease Control and Prevention. Guidelines for Preventing the Transmission of Mycobacterium tuberculosis in Health-Care Settings, 2005. MMWR Recomm Rep 2005 Dec 30;54(RR-17):1-141.

71. Association for Professionals in Infection Control and Epidemiology (APIC). Urgent/Emergency Care Centers. Infection Control in Ambulatory Care. Jones and Bartlett Publishers, Inc.; 2004. pp. 129-34.

72. A Strategy for the Control of Antimicrobial Resistance in Ireland (SARI). Infection Prevention and Control Building Guidelines for Acute Hospitals in Ireland. Ireland: HSE Health Protection Surveillance Centre; 2008 Dec.

73. Comité sur les infections nosocomiales du Québec. Stratégies de prévention des infections lors du processus d'évaluation des patients en milieu de soins. Institut national de santé publique du Québec; 2004 Jan 26.

74. Lobo RR, Borges MC, Neves FF, Vidal de Moura NB, Colleto FA, Romeo Boullosa JL, et al. Impact of implementing an exclusively dedicated respiratory isolation room in a Brazilian tertiary emergency department. Emerg Med J 2011 Sep;28(9):754-7.

75. Lowe AM et al. Survet of infection contol measures and design of emergeny rooms in Quebec, Canada: an overview of the actual situation. International Conference on Prevention and Infection Control (ICPIC). 2011.

76. Anathallee M, Curphey A, Beeching N, Carley S, Crawford I, Mackway-Jones K. Emergency departments (EDs) in the United Kingdom (UK) are not prepared for emerging biological threats and bioterrorism. J Infect 2007 Jan;54(1):12-7.

77. Humphreys H. Control and prevention of healthcare-associated tuberculosis: the role of respiratory isolation and personal respiratory protection. J Hosp Infect 2007 May;66(1):1-5.

78. Siegel JD, Rhinehart E, Jackson M, Chiarello L. Management of Multidrug-Resistant Organisms in Health Care Settings, 2006. Am J Infect Control 2007 Dec;35(10 Suppl 2):S165-S193.

79. Humphreys H. Positive-pressure isolation and the prevention of invasive aspergillosis. What is the evidence? J Hosp Infect 2004 Feb;56(2):93-100.

80. Comité sur les infections nosocomiales du Québec. Proportion de civières individuelles avec salle de toilette non partagée devant être disponible dans les établissements de santé physique du Québec. Institut national de santé publique du Québec; 2010 Aug.

81. MacCannell T, Umscheid CA, Agarwal RK, Lee I, Kuntz G, Stevenson KB. Guideline for the Prevention and Control of Norovirus Gastroenteritis Outbreaks in Healthcare Settings. Infect Control Hosp Epidemiol 2011 Oct;32(10):939-69.

82. Comité sur les infections nosocomiales du Québec. Mesures de contrôle et prévention des éclosions de cas de gastro-entérite infectieuse d'allure virale (norovirus) à l'intention des établissements de soins. Institut national de santé publique du Québec; 2005 Jun.

83. Gardam M, Lemieux C, Reason P. Healthcare-associated infections as patient safety indicators. Healthcare papers 2009;9(3):8-24.

84. Rudel-Tessier C. Enquête publique portant sur la recherche des causes et des circonstances de décès de seize personnes survenus à l'Hôpital de Saint-Hyacinthe, entre mai et novembre 2006, alors que sévissait la bactérie Clostridium difficile. Ministère de la Sécurité Publique - Gouvernement du Québec; 2007 Sep.

85. Dowdeswell B, Erskine J, Heasman M. Hospital Ward Configuration: Determinants Influencing Single Room Provision. EU Health Property Network; 2004 Nov.

86. Mayot R, Lance J. Utilisation de chambres simples et de chambres doubles pour le contrôle des infections nosocomiales. Agence d'évaluation des technologies et des modes d'intervention en santé (AETMIS); 2007 Oct.

87. Farquharson C, Baguley K. Responding to the severe acute respiratory syndrome (SARS) outbreak: lessons learned in a Toronto emergency department. J Emerg Nurs 2003 Jun;29(3):222-8.

88. Alfa MJ, Lo E, Wald A, Dueck C, Degagne P, Harding GK. Improved eradication of Clostridium difficile spores from toilets of hospitalized patients using an accelerated hydrogen peroxide as the cleaning agent. BMC Infect Dis 2010;10:268.

89. Alfa MJ, Dueck C, Olson N, DeGagne P, Papetti S, Wald A, et al. UV-visible marker confirms that environmental persistence of Clostridium difficile spores in toilets of patients with C. difficile-associated diarrhea is associated with lack of compliance with cleaning protocol.e. BMC Infect Dis 2008;8:64.

90. Noble MA, Isaac-Renton JL, Bryce EA, Roscoe DL, Roberts FJ, Walker M, et al. The toilet as a transmission vector of vancomycin-resistant enterococci. J Hosp Infect 1998 Nov;40(3):237-41.

91. Boyce JM, Havill NL, Otter JA, Adams NM. Widespread Environmental Contamination Associated With Patients with Diarrhea and Methicillin-Resistant Staphylococcus aureus Colonization of the Gastrointestinal Tract. Infect Control Hosp Epidemiol 2007 Oct;28(10):1142-7.

92. Bartley JM, Olmsted RN, Haas J. Current views of health care design and construction: Practical implications for safer, cleaner environments. Am J Infect Control 2010 Jun;38(5 Suppl 1):S1-12.

93. Boyce J, Pittet D. Guideline for Hand Hygiene in Health-Care Settings. MMWR 2002 Oct 25;51:1-44.

94. Canadian Patient Safety Institute. Your 4 Moments for Hand Hygiene. 2006.

95. Siegel JD, Rhinehart E. 2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings. Centers for Disease Control and Prevention; 2007.

96. Li Y, Chwang A. Understanding droplets produced by nebulisers and respiratory activities. Hong Kong Med J 2008;14:S29-32.

97. CIPIN. Principes généraux d'aménagement en prévention et contrôle des infections nosocomiales (2nd edition). 2012 Jun. Report No.: 1.

98. Murray M, Bullard M, Grafstein E. [Revisions to the Canadian Emergency Department Triage and Acuity Scale Implementation Guidelines]. CJEM 2005 Jan;7(1):28-35.

99. The Canadian Association of Emergency Physicians. Taking action on the issue of overcrowding in Canada's emergency departments. 2005 Jun 16.

100. Beveridge R, Clark B, Janes L. Canadian Emergency Department Triage and Acuity Scale: Implementation Guidelines. CMAJ 1999;1(Suppl):S2-S28.

101. Kirby A. Rotavirus and norovirus infections in children in Sana'a, Yemen. Tropical Medicine and International Health 2011;1-5.

102. Vardy J, Love AJ, Dignon N. Outbreak of acute gastroenteritis among emergency department staff. Emerg Med J 2007 Oct;24(10):699-702.

103. Yee EL, Staat MA, Azimi P, Bernstein DI, Ward RL, Schubert C, et al. Burden of rotavirus disease among children visiting pediatric emergency departments in Cincinnati, Ohio, and Oakland, California, in 1999-2000. Pediatrics 2008 Nov;122(5):971-7.

104. Oostenbrink R, Moons KG, Theunissen CC, Derksen-Lubsen G, Grobbee DE, Moll HA. Signs of meningeal irritation at the emergency department: How often bacterial meningitis? Pediatr Emerg Care 2001 Jun;17(3):161-4.

105. Rosenberg P, McIsaac W, Macintosh D, Kroll M. Diagnosing streptococcal pharyngitis in the emergency department: Is a sore throat score approach better than rapid streptococcal antigen testing? CJEM 2002 May;4(3):178-84.

106. Harding AD, Almquist LJ, Hashemi S. The Use and Need for Standard Precautions and Transmission-Based Precautions in the Emergency Department. J Emerg Nurs 2011 Jul;37(4):367-73.

107. Clauss H. Prevalence and characteristics of patients with undiagnosed HIV infection in an urban emergency department. AIDS patient care and STD 2011;25:1-5.

108. Hall CB. The Burgeoning Burden of Respiratory Syncytial Virus Among Children. Infect Disord Drug Targets 2012 Apr;12(2):92-7.

109. McGrath NE. Children with chickenpox: emergency department care and teaching. J Emerg Nurs 1992 Aug;18(4):353-4.

110. Gehanno JF, Pestel-Caron M, Nouvellon M, Caillard JF. Nosocomial Pertussis in Healthcare Workers from a Pediatric Emergency Unit in France. Infect Control Hosp Epidemiol 1999 Aug;20(8):549-52.

111. Seguin D, Stoner HJ. Triage of a febrile patient with a rash: a comparison of chickenpox, monkeypox, and smallpox. Disaster Manag Response 2004 Jul;2(3):81-6.

112. Comité sur les infections nosocomiales du Québec. Prévention de la transmission des maladies respiratoires sévères d'origine infectieuse (MRSI), de l'influenza aviaire A(H5N1) et de la grippe A(H1N1) d'origine porcine dans les milieux de soins – mise à jour des recommandations portant sur la grippe A(H1N1). Institut national de santé publique du Québec; 2009 Jun 29.

113. Centre for Infectious Disease Prevention and Control (CIDPC). Canadian Pandemic Influenza Plan for the Health Sector. Ottawa; 2006.

114. Ministry of Health and Long-Term Care. Ontario Health Plan for an Influenza Pandemic. Toronto; 2008.

115. Centers for Disease Control and Prevention. Interim Guidance on Planning for the Use of Surgical Masks and Respirators in Health Care Settings during an Influenza Pandemic. 2006.

116. Yen M, Lu Y, Huang P. Quantitative evaluation of infection control models in the prevention of nosocomial transmission of SARS virus to healthcare workers: implication to nosocomial viral infection control for healthcare workers. Scandinavian Journal of Infectious Diseases 2010;1-6.

117. Tham KY. An emergency department response to severe acute respiratory syndrome: a prototype response to bioterrorism. Ann Emerg Med 2004 Jan;43(1):6-14.

118. Toronto Academic Health Services Network (TAHSN). Toronto Academic Health Services Network: Pandemic Influenza Planning Guidelines. Toronto; 2006.

119. Department of Health (UK). Pandemic Flu: A National Framework for Responding to an Influenza Pandemic. London; 2007.

120. Department of Health (UK). Pandemic Influenza: Guidance for Infection Control in Hospitals and Primary Care Settings. United Kingdom; 2007.

121. Department of Health and Ageing (Australia). Interim Infection Control Guidelines for Pandemic Influenza in Healthcare and Community Settings. Australia; 2006.

122. Health Canada. Infection Control Precautions for Respiratory Infections Transmitted by Large Droplet and Contact: Infection Control Guidance in a Non-Outbreak Setting, When an Individual Presents to a Health Care Institution with a Respiratory Infection. 2003 Dec 17.

123. Direction de la protection de la santé publique. Surveillance accrue des maladies respiratoires sévères émergentes d'origine infectieuse. MSSS; 2011.

124. Comité sur les infections nosocomiales du Québec. Mesures de prévention et contrôle de la grippe pandémique H1N1 lors d'une vague pandémique pour les établissements de soins aigus, les soins ambulatoires et les soins à domicile. Institut national de santé publique du Québec; 2009 Nov.

125. Afilalo M, Stern E, Oughton M. Evaluation and management of seasonal influenza in the emergency department. Emerg Med Clin North Am 2012 May;30(2):271-305, viii.

126. Fleming K, Randle J. Toys--friend or foe? A study of infection risk in a paediatric intensive care unit. Paediatr Nurs 2006 May;18(4):14-8.

127. Avila-Aguero ML, German G, Paris MM, Herrera JF. Toys in a pediatric hospital: Are they a bacterial source? Am J Infect Control 2004 Aug;32(5):287-90.

128. Desai R, Pannaraj PS, Agopian J, Sugar CA, Liu GY, Miller LG. Survival and transmission of community-associated methicillin-resistant Staphylococcus aureus from fomites. Am J Infect Control 2011 Apr;39(3):219-25.

129. Boone SA, Gerba CP. The occurrence of influenza A virus on household and day care center fomites. J Infect 2005 Aug;51(2):103-9.

130. Pappas DE, Hendley JO, Schwartz RH. Respiratory viral RNA on toys in pediatric office waiting rooms. Pediatr Infect Dis J 2010 Feb;29(2):102-4.

131. Merriman E, Corwin P, Ikram R. Toys are a potential source of cross-infection in general practitioners' waiting rooms. Br J Gen Pract 2002 Feb;52(475):138-40.

132. Charnock C. Swabbing of waiting room magazines reveals only low levels of bacterial contamination. Br J Gen Pract 2005 Jan;55(510):37-9.

133. Boone SA, Gerba CP. Significance of Fomites in the Spread of Respiratory and Enteric Viral Disease. Appl Environ Microbiol 2007 Mar;73(6):1687-96.

134. Abad FX, Pinto RM, Bosch A. Survival of Enteric Viruses on Environmental Fomites. Appl Environ Microbiol 1994 Oct;60(10):3704-10.

135. Abad FX, Villena C, Guix S, Caballero S, Pinto RM, Bosch A. Potential Role of Fomites in the Vehicular Transmission of Human Astroviruses. Appl Environ Microbiol 2001 Sep;67(9):3904-7.

136. Prince H, Prince D. Principles of Viral Control and Transmission. In: Seymour S. Bloc, editor. Disinfection, Sterilization, and Preservation. 5th ed. Lippincott Williams & Wilkins; 2011. pp. 543-71.

137. Hospital epidemiology and infection control: toy cleaning, 5.3, University of California (San Francisco), (2007).

138. Association for Professionals in Infection Control and Epidemiology (APIC). Isolation Precautions. Infection Control in Ambulatory Care. 2004. pp. 39-46.

139. Feigin RD, Baker CJ, Herwaldt LA, Lampe RM, Mason EO, Whitney SE. Epidemic meningococcal disease in an elementary-school classroom. N Engl J Med 1982 Nov 11;307(20):1255-7.

140. Turnberg W, Daniell W, Seixas N, Simpson T, Van BJ, Lipkin E, et al. Appraisal of recommended respiratory infection control practices in primary care and emergency department settings. Am J Infect Control 2008 May;36(4):268-75.

141. Association pour la santé et la sécurité du travail secteur affaires sociales. Guide de référence en prévention des infections. 2000 Jan 24.

142. Puro V, Fusco FM, Lanini S, Nisii C, Ippolito G. Risk management of febrile respiratory illness in emergency departments. New Microbiol 2008 Apr;31(2):165-73.

143. Centers for Disease Control and Prevention. Guide to Infection Prevention for Outpatient Settings: Minimum Expectations for Safe Care. 2011 Jul.

144. Centers for Disease Control and Prevention (CDC). Respiratory Hygiene/Cough Etiquette in Healthcare Settings. Department of Health and Human Services 2009 August URL: http://www.cdc.gov/flu/professionals/infectioncontrol/resphygiene.htm.

145. Ordre des infirmières et infirmiers du Québec. La tenue vestimentaire des infirmières - prise de position. 2006.

146. Collins M. High impact interventions to control infection. Emerg Nurse 2010 Mar;17(10):12-7.

147. Aucoin L. Comité d'examen sur la prévention et le contrôle des infections nosocomiales. D'abord, ne pas nuire... Les infections nosocomiales au Québec, un problème majeur de santé publique, une priorité. MSSS; 2005.

148. Anderson DJ, Kaye KS, Classen D, Arias KM, Podgorny K, Burstin H, et al. Strategies to Prevent Surgical Site Infections in Acute Care Hospitals. Infect Control Hosp Epidemiol 2008 Oct;29 Suppl 1:S51-S61.

149. Kelen GD, Green GB, Hexter DA, Fortenberry DC, Taylor E, Fleetwood DH, et al. Substantial improvement in compliance with universal precautions in an emergency department following institution of policy. Arch Intern Med 1991 Oct;151(10):2051-6.

150. Provincial Infectious Diseases Advisory Committee (Ontario). Routine Practices and Additional Precautions in All Health Care Settings. Ministry of Health and Long-Term Care; 2009 Aug.

151. Jackson MM, Lynch P. Isolation practices: a historical perspective. Am J Infect Control 1985 Feb;13(1):21-31.

152. Garvin KL, Urban JA. Emerging multiresistant strains: recommended precautions in the emergency room and surgical setting. Instr Course Lect 2000;49:605-14.

153. Skowronski DM, Petric M, Daly P, Parker RA, Bryce E, Doyle PW, et al. Coordinated Response to SARS, Vancouver, Canada. Emerg Infect Dis 2006 Jan;12(1):155-8.

154. Evanoff B, Kim L, Mutha S, Jeffe D, Haase C, Andereck D, et al. Compliance with universal precautions among emergency department staff caring for trauma patients. Ann Emerg Med 1999 Feb;33(2):160-5.

155. Henry K, Campbell S, Maki M. A comparison of observed and self-reported compliance with universal precautions among emergency department staff at a Minnesota public teaching hospital: implications for assessing infection control programs. Ann Emerg Med 1992 Aug;21(8):940-6.

156. Al-Damouk M, Pudney E, Bleetman A. Hand hygiene and aseptic technique in the emergency department. J Hosp Infect 2004 Feb;56(2):137-41.

157. Erasmus V, Daha TJ, Brug H, Richardus JH, Behrendt MD, Vos MC, et al. Systematic Review of Studies on Compliance with Hand Hygiene Guidelines in Hospital Care. Infect Control Hosp Epidemiol 2010 Mar;31(3):283-94.

158. Wendt C, Knautz D, von BH. Differences in Hand Hygiene Behavior Related to the Contamination Risk of Healthcare Activities in Different Groups of Healthcare Workers. Infect Control Hosp Epidemiol 2004 Mar;25(3):203-6.

159. Pittet D, Mourouga P, Perneger TV. Compliance with handwashing in a teaching hospital. Infection Control Program. Ann Intern Med 1999 Jan 19;130(2):126-30.

160. Meengs MR, Giles BK, Chisholm CD, Cordell WH, Nelson DR. Hand washing frequency in an emergency department. Ann Emerg Med 1994 Jun;23(6):1307-12.

161. Lankford MG, Collins S, Youngberg L, Rooney DM, Warren JR, Noskin GA. Assessment of materials commonly utilized in health care: implications for bacterial survival and transmission. Am J Infect Control 2006 Jun;34(5):258-63.

162. Steed C, Kelly JW, Blackhurst D, Boeker S, Diller T, Alper P, et al. Hospital hand hygiene opportunities: Where and when (HOW2)? The HOW2 Benchmark Study. Am J Infect Control 2011 Feb;39(1):19-26.

163. World Health Organization (WHO). WHO Guidelines on Hand Hygiene in Health Care - First Global Patient Safety Challenge Clean Care is Safer Care. Geneva, Switzerland; 2009.

164. Canadian Patient Safety Institute. Canada's Hand Hygiene Challenge: STOP! Clean Your Hands. Hand Hygiene Toolkit. 2010.

165. Abela N, Borg MA. Impact on hand hygiene compliance following migration to a new hospital with improved resources and the sequential introduction of World Health Organization recommendations. Am J Infect Control 2012 Jan 26.

166. Saint S, Conti A, Bartoloni A, Virgili G, Mannelli F, Fumagalli S, et al. Improving healthcare worker hand hygiene adherence before patient contact: a before-and-after five-unit multimodal intervention in Tuscany. Qual Saf Health Care 2009 Dec;18(6):429-33.

167. Dorsey ST, Cydulka RK, Emerman CL. Is Handwashing Teachable?: Failure to Improve Handwashing Behavior in an Urban Emergency Department. Acad Emerg Med 1996 Apr;3(4):360-5.

168. Pittet D. Improving Adherence to Hand Hygiene Practice: A Multidisciplinary Approach. Emerg Infect Dis 2001 Mar;7(2):234-40.

169. Larson EL, Albrecht S, O'Keefe M. Hand Hygiene Behavior in a Pediatric Emergency Department and a Pediatric Intensive Care Unit: Comparison of Use of 2 Dispenser Systems. Am J Crit Care 2005 Jul;14(4):304-11.

170. Haas JP, Larson EL. Impact of Wearable Alcohol Gel Dispensers on Hand Hygiene in an Emergency Department. Acad Emerg Med 2008 Apr;15(4):393-6.

171. Lankford MG, Zembower TR, Trick WE, Hacek DM, Noskin GA, Peterson LR. Influence of Role Models and Hospital Design on Hand Hygiene of Health Care Workers. Emerg Infect Dis 2003 Feb;9(2):217-23.

172. Victoria Government. Improving the Patient Experience Program. Australia; 2007.

173. Venkatesh AK, Pallin DJ, Kayden S, Schuur JD. Predictors of Hand Hygiene in the Emergency Department. Infect Control Hosp Epidemiol 2011 Nov;32(11):1120-3.

174. Brouqui P, Puro V, Fusco FM, Bannister B, Schilling S, Follin P, et al. Infection control in the management of highly pathogenic infectious diseases: consensus of the European Network of Infectious Disease. Lancet Infect Dis 2009 May;9(5):301-11.

175. Longtin Y, Akakpo C, Rutschmann OT, Pittet D, Sax H. Evaluation of Patients' Mask Use after the Implementation of Cough Etiquette in the Emergency Department. Infect Control Hosp Epidemiol 2009 Sep;30(9):904-8.

176. Centers for Disease Control and Prevention. Public Health Guidance for Community-Level Preparedness and Response to Severe Acute Respiratory Syndrome (SARS): Version 2: Supplement C: Preparedness and Response in Health Care Facilities. 2004 Jan 8.

177. Centers for Disease Control and Prevention. Respiratory Hygiene/Cough Etiquette in Healthcare Settings. CDC 2009 August 1 URL: http://www.cdc.gov/flu/professionals/infectioncontrol/resphygiene.htm.

178. Department of Human Services of Victoria. Status report - emergency department waiting rooms - Audit of Victorian public hospital emergency department waiting rooms. Australia; 2005 Jan.

179. Public Health Agency of Canada (PHAC). Guidance: Infection Prevention and Control Measures for Healthcare Workers in Acute Care and Long-Term Care Settings. Public Health Agency of Canada 2010 URL: http://www.phac-aspc.gc.ca/nois-sinp/guide/ac-sa-eng.php.

180. Comité sur les infections nosocomiales du Québec. Mesures de prévention et de contrôle de la grippe saisonnière en centre hospitalier de soins généraux et spécialisés. Institut national de santé publique du Québec; 2012 Jan.

181. Sayed ME, Kue R, McNeil C, Dyer KS. A descriptive analysis of occupational health exposures in an urban emergency medical services system: 2007-2009. Prehosp Emerg Care 2011 Oct;15(4):506-10.

182. Reid SM, Farion KJ, Suh KN, Audcent T, Barrowman NJ, Plint AC. Use of personal protective equipment in Canadian pediatric emergency departments. CJEM 2011 Mar;13(2):71-8.

183. Madan AK, Raafat A, Hunt JP, Rentz D, Wahle MJ, Flint LM. Barrier precautions in trauma: is knowledge enough? J Trauma 2002 Mar;52(3):540-3.

184. Mitchell R, Ogunremi T, Astrakianakis G, Bryce E, Gervais R, Gravel D, et al. Impact of the 2009 influenza A (H1N1) pandemic on Canadian health care workers: A survey on immunization, illness, absenteeism, and personal protective equipment. Am J Infect Control 2012 May 8.

185. Lateef F. Hospital design for better infection control. J Emerg Trauma Shock 2009 Sep;2(3):175-9.

186. Sharps disposal containers. Health Devices 2003 Jul;32(7):253-72.

187. Perry J, Jagger J, Parker G, Phillips EK, Gomaa A. Disposal of sharps medical waste in the United States: Impact of recommendations and regulations, 1987-2007. Am J Infect Control 2011 Aug 6.

188. Greenaway C, Menzies D, Fanning A, Grewal R, Yuan L, FitzGerald JM. Delay in Diagnosis among Hospitalized Patients with Active Tuberculosis--Predictors and Outcomes. Am J Respir Crit Care Med 2002 Apr 1;165(7):927-33.

189. Moran GJ, McCabe F, Morgan MT, Talan DA. Delayed Recognition and Infection Control for Tuberculosis Patients in the Emergency Department. Ann Emerg Med 1995 Sep;26(3):290-5.

190. Redd JT, Susser E. Controlling Tuberculosis in an Urban Emergency Department: A Rapid Decision Instrument for Patient Isolation. Am J Public Health 1997 Sep;87(9):1543-7.

191. Tipple M, Heirendt W, Metchock B. Tuberculosis Outbreak in a Community Hospital - District of Columbia. MMWR 2002;(53).

192. Garcia-Vidal C, Barba P, Arnan M, Moreno A, Ruiz-Camps I, Gudiol C, et al. Invasive Aspergillosis Complicating Pandemic Influenza A (H1N1) Infection in Severely Immunocompromised Patients. Clin Infect Dis 2011 Sep;53(6):e16-e19.

193. Marschall J, Mermel LA, Classen D, Arias KM, Podgorny K, Anderson DJ, et al. Strategies to Prevent Central Line–Associated Bloodstream Infections in Acute Care Hospitals. Infect Control Hosp Epidemiol 2008 Oct;29 Suppl 1:S22-S30.

194. O'Grady N, Alexander M, Burns L. Guidelines for the Prevention of Intravascular Catheter-Related Infections, 2011. 2012.

195. Gokula RM, Smith MA, Hickner J. Emergency room staff education and use of a urinary catheter indication sheet improves appropriate use of foley catheters. Am J Infect Control 2007 Nov;35(9):589-93.

196. Canadian Campaign Safer Healthcare Now! Prevent Central Line–Associated Bloodstream Infections. 2012 Jun.

197. Centers for Disease Control and Prevention. Guidelines for Preventing Health Care Associated Pneumonia, 2003. MMWR 2004 Mar 26;53(RR03):1-36.

198. Coffin S, Klompas M, Classen D. Strategies to Prevent Ventilator-Associated Pneumonia in Acute Care Hospitals. Infection Control and Hospital Epidemiology 2008 Oct;29(1).

199. Canadian Campaign Safer Healthcare Now! Prevent Ventilator Associated Pneumonia. 2012 Jun.

200. Grap MJ, Munro CL, Unoki T, Hamilton VA, Ward KR. Ventilator-associated pneumonia: the potential critical role of emergency medicine in prevention. J Emerg Med 2012 Mar;42(3):353-62.

201. Burnett KP, Erickson D, Hunt A, Beaulieu L, Bobo P, Shute P. Strategies to Prevent Urinary Tract Infection from Urinary Catheter Insertion in the Emergency Department. J Emerg Nurs 2010 Nov;36(6):546-50.

202. Turnberg W, Daniell W, Simpson T, Van BJ, Seixas N, Lipkin E, et al. Personal Healthcare Worker (HCW) and Work-Site Characteristics that Affect HCWs' Use of Respiratory-Infection Control Measures in Ambulatory Healthcare Settings. Infect Control Hosp Epidemiol 2009 Jan;30(1):47-52.

203. Vandijck DM, Labeau SO, Secanell M, Rello J, Blot SI. The role of nurses working in emergency and critical care environments in the prevention of intravascular catheter-related bloodstream infections. Int Emerg Nurs 2009 Jan;17(1):60-8.

204. Moskop JC, Sklar DP, Geiderman JM, Schears RM, Bookman KJ. Emergency department crowding, part 2--barriers to reform and strategies to overcome them. Ann Emerg Med 2009 May;53(5):612-7.

205. Sprivulis PC, Da Silva JA, Jacobs IG, Frazer AR, Jelinek GA. The Association Between Hospital Overcrowding and Mortality Among Patients Admitted via Western Australian Emergency Departments. Med J Aust 2006 Mar 6;184(5):208-12.

206. Chalfin DB, Trzeciak S, Likourezos A, Baumann BM, Dellinger RP. Impact of delayed transfer of critically ill patients from the emergency department to the intensive care unit. Crit Care Med 2007 Jun;35(6):1477-83.

207. World Health Organization. What are the health risks related to overcrowding? World Health Organization Web site 2011 URL: http://www.who.int/water_sanitation_health/emergencies/qa/emergencies_qa9/en/index.html#.

208. Johnson KD, Winkelman C. The effect of emergency department crowding on patient outcomes: a literature review. Adv Emerg Nurs J 2011 Jan;33(1):39-54.

209. Moskop JC, Sklar DP, Geiderman JM, Schears RM, Bookman KJ. Emergency department crowding, part 1--concept, causes, and moral consequences. Ann Emerg Med 2009 May;53(5):605-11.

210. Kilcoyne M, Dowling M. Working in an overcrowded accident and emergency department: nurses' narratives. Australian Journal of Advanced Nursing 2011;25(2):21-7.

211. Schull MJ, Redelmeier DA. Infection control for the disinterested. CMAJ 2003 Jul 22;169(2):122-3.

212. Booth CM, Matukas LM, Tomlinson GA, Rachlis AR, Rose DB, Dwosh HA, et al. Clinical Features and Short-Term Outcomes of 144 Patients with SARS in the Greater Toronto Area. JAMA 2003 Jun 4;289(21):2801-9.

213. Harbarth S, Sudre P, Dharan S, Cadenas M, Pittet D. Outbreak of Enterobacter cloacae Related to Understaffing, Overcrowding, and Poor Hygiene Practices. Infection Control and Hospital Epidemiology 1999 Sep 1;20(9):598-603.

214. The Canadian Association of Emergency Physicians. Position statement on emergency department overcrowding. Ottawa; 2007 Feb.

215. Garson C, Hollander JE, Rhodes KV, Shofer FS, Baxt WG, Pines JM. Emergency department patient preferences for boarding locations when hospitals are at full capacity. Ann Emerg Med 2008 Jan;51(1):9-12, 12.

216. Walsh P, Cortez V, Bhakta H. Patients would prefer ward to emergency department boarding while awaiting an inpatient bed. J Emerg Med 2008 Feb;34(2):221-6.

217. Administrative Policies & Procedures Manual Code: LD:0065, Stony Brook University Hospital & Medical Center - State University of New York, (2006).

218. Longtin Y. Avis et recommandations du Comité sur les infections nosocomiales du Québec: Rideaux séparateurs et risque infectieux. Institut national de santé publique du Québec; 2012.

219. Klakus J, Vaughan NL, Boswell TC. Methicillin-resistant Staphylococcus aureus contamination of hospital curtains. J Hosp Infect 2008 Feb;68(2):189-90.

220. Trillis F, III, Eckstein EC, Budavich R, Pultz MJ, Donskey CJ. Contamination of Hospital Curtains with Healthcare-Associated Pathogens. Infect Control Hosp Epidemiol 2008 Nov;29(11):1074-6.

221. Conference call - background. Anne-Marie Lowe, editor. 2-21-2011. Ref Type: Personal Communication.

222. Heijne JC, Teunis P, Morroy G, Wijkmans C, Oostveen S, Duizer E, et al. Enhanced Hygiene Measures and Norovirus Transmission during an Outbreak. Emerg Infect Dis 2009 Jan;15(1):24-30.

223. Dalling J. A review of environmental contamination during outbreaks of Norwalk-like virus. British Journal of Infection Control 2004 Apr;(5):9-13.

224. Giannini MA, Nance D, McCullers JA. Are toilet seats a vector for transmission of methicillin-resistant Staphylococcus aureus? Am J Infect Control 2009 Aug;37(6):505-6.

225. Eckstein BC, Adams DA, Eckstein EC, Rao A, Sethi AK, Yadavalli GK, et al. Reduction of Clostridium difficile and vancomycin-resistant Enterococcus contamination of environmental surfaces after an intervention to improve cleaning methods. BMC Infect Dis 2007;7:61.

226. Blennerhasset L. Door selection not an open and shut case. Health Estate 2008 Jun;62(6):53-5.

227. Bartley J, Streifel AJ. Design of the environment of care for safety of patients and staff: does form follow function or vice versa in the intensive care unit? Crit Care Med 2010 Aug;38(8 Suppl):S388-S398.

228. Attribution des zones grises en hygiène et salubrité, 2012-003, Sous-ministre associé à la Direction générale de la coordination, du financement, des immobilisations et du budget, (2012).

229. Jansen I, Murphy J. Environmental cleaning and healthcare-associated infections. Healthc Pap 2009;9(3):38-43.

230. Ministère de la Santé et des Services sociaux. Mesures d'hygiène et de salubrité au regard du Clostridium difficile - Lignes directrices. 2008 May.

231. Talan DA, Partida CN. Emergency Department Ultrasound Infection Control: Do Unto (and Into) Others. Ann Emerg Med 2011 Jul;58(1):64-6.

232. Albert NM, Hancock K, Murray T, Karafa M, Runner JC, Fowler SB, et al. Cleaned, Ready-to-Use, Reusable Electrocardiographic Lead Wires as a Source of Pathogenic Microorganisms. Am J Crit Care 2010 Nov;19(6):e73-e80.

233. Frazee BW, Fahimi J, Lambert L, Nagdev A. Emergency department ultrasonographic probe contamination and experimental model of probe disinfection. Ann Emerg Med 2011 Jul;58(1):56-63.

234. Embil JM, Zhanel GG, Plourde PJ, Hoban D. Scissors: A Potential Source of Nosocomial Infection. Infect Control Hosp Epidemiol 2002 Mar;23(3):147-51.

235. Contamination of Stethoscopes and Physicians' Hands Following a Single Physical Examination: A Comparative Analysis. 49th ICAAC. 9-13-2009. Ref Type: Abstract.

236. Mangi RJ, Andriole VT. Contaminated Stethoscopes: A Potential Source of Nosocomial Infections. Yale J Biol Med 1972 Dec;45(6):600-4.

237. Uneke CJ, Ogbonna A, Oyibo PG, Onu CM. Bacterial contamination of stethoscopes used by health workers: public health implications. J Infect Dev Ctries 2010 Jul;4(7):436-41.

238. British Columbia Center for Disease Control. Guidelines for Infection Prevention and Control in the Physicians' Office. 2004.

239. Association for Professionals in Infection Control and Epidemiology (APIC). Physician Offices and Clinics. Infection Control in Ambulatory Care. 2004. pp. 47-58.

240. Fiche technique 7: Gestion des excréta dans les établissements de santé et médico-sociaux. Centre de coordination de lutte contre les infections nosocomiales - Paris nord 2010.

241. Agence d'évaluation des technologies et des modes d'intervention en santé (AETMIS). Analyse comparative des équipements de traitement des bassines de lit. 2009 May 7.

242. Public Health Agency of Canada. Prevention and Control of Occupational Infections in Health Care. 2002 Mar.

243. Ministère de la Santé et des Services sociaux. Protocole d'immunisation du Québec. 2012 Apr.

244. Bass SB, Gordon TF, Ruzek SB, Hausman AJ. Mapping perceptions related to acceptance of smallpox immunization by hospital emergency room staff. Biosecur Bioterror 2008 Jun;6(2):179-90.

245. Saluja I, Theakston KD, Kaczorowski J. Influenza immunization rate among emergency department staff: a survey of four teaching hospitals. CJEM 2005 Jan;7(1):17-21.

246. Green M, Levin J, Michaels M. Hospital-Associated Measles Outbreak - Pennsylvania, March-April 2009. MMWR 2012 Jan 20;61(2):30-2.

247. Thomas DR, Winsted B, Koontz C. Improving neglected influenza immunization among healthcare workers in long-term care. J Am Geriatr Soc 1993 Sept;41(9):928-30.

248. Harty-Golder B. Sick employees at work create serious problems. MLO Med Lab Obs 2006 May;38(5):34.

249. Public Health Agency of Canada. Construction-related Nosocomial Infections in Patients in Health Care Facilities. 2001 Jul.

250. Lo E, Nicolle L, Classen D, Arias KM, Podgorny K, Anderson DJ, et al. Strategies to Prevent Catheter-Associated Urinary Tract Infections in Acute Care Hospitals. Infect Control Hosp Epidemiol 2008 Oct;29 Suppl 1:S41-S50.

251. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for Prevention of Surgical Site Infection, 1999. Centers for Disease Control and Prevention (CDC) Hospital Infection Control Practices Advisory Committee. Am J Infect Control 1999 Apr;27(2):97-132.

252. Lowe A, Roy M. Surveillance des infections du site opératoire: outils et methodologies pour les milieux de soins [avis scientifique en cours]. Institut national de santé publique du Québec; 2012.

253. Frenette C, Bois R. Surveillance des diarrhées associées au Clostridium difficile dans les centres hospitaliers du Québec. Institut national de santé publique du Québec; 2010.

254. Liste des maladies, infections et intoxications à déclaration obligatoire (MADO). Ministère de la Santé et des Services Sociaux 2012 [cited 2012 Aug 15]; URL: http://publications.msss.gouv.qc.ca/acrobat/f/documentation/preventioncontrole/03-268-05.pdf.

255. Ministère de la Santé et des Services sociaux. Les maladies à déclaration obligatoire. Gouvernement du Québec 2012 [cited 2012 Aug 15]; URL: http://www.msss.gouv.qc.ca/professionnels/mado/index.php.

256. Chapter 9: Some Legal and Ethical Issues Raised by SARS and Infectious Diseases in Canada. Public Agency of Canada 2004 November 8 [cited 2012 Aug 15]; URL: http://www.phac-aspc.gc.ca/publicat/sars-SARS/naylor/9-eng.php.

257. Ministère de la Santé et des Services sociaux. Système de surveillance de la grippe. Gouvernement du Québec 2012 [cited 2012 Aug 16]; URL: http://www.msss.gouv.qc.ca/sujets/prob_sante/influenza/index.php?systeme_de_surveillance.

258. Bénet T, Cassier P, Voirin N. Correlation between emergency room visits for influenza-like illness during the influenza A (H1/N1) pandemic in children and adults. Influenza and other respiratory viruses 2012 Jul 21;1-4.

259. Comité sur les infections nosocomiales du Québec. Mesures de prévention et contrôle de l'entérocoque résistant à la vancomycine dans les milieux de soins aigus du Québec. Institut national de santé publique du Québec; 2012 Sep.

260. Schull MJ, Stukel TA, Zwarenstein M, Guttmann A, Alter DA, Manuel DG. ICES Report: Five Policy Recommendations from Toronto's SARS Outbreak to Improve the Safety and Efficacy of Restrictions on Hospital Admissions to Manage Infectious Disease Outbreaks. Healthc Q 2009;12(1):30-2.

261. APIC Bioterrorism Task Force, CDC Hospital Infections Program Bioterrorism Working Group. Bioterrorism Readiness Plan: A Template for Healthcare Facilities. 1999 Apr 13.

262. Rebmann T, Wilson R, LaPointe S, Russell B, Moroz D. Hospital infectious disease emergency preparedness: a 2007 survey of infection control professionals. Am J Infect Control 2009 Feb;37(1):1-8.

263. Association for Professionals in Infection Control and Epidemiology (APIC). Bioterrorism. Infection Control in Ambulatory Care. 2004. pp. 183-7.

264. Timen A, Hulscher ME, Rust L, van Steenbergen JE, Akkermans RP, Grol RP, et al. Barriers to implementing infection prevention and control guidelines during crises: Experiences of health care professionals. Am J Infect Control 2010 Nov;38(9):726-33.

265. Code of ethics of physicians, R.R.Q. C.M.-9, r.17, Collège des médecins, (2010).

266. Code of ethics of nurses, c. I-8, r. 9, Gouvernement du Québec, (2011).

267. Fernand Guillemette. Capsule d'information: Rougeole. Agence de la santé et des services sociaux de la Mauricie et du Centre-du-Québec (Direction de la santé publique) 2011 April 13.

268. World Health Organization. WHO Outbreak communication guidelines. 2005.

269. Robinson KS, Jagim MM, Ray CE. Nursing Workforce Issues and Trends Affecting Emergency Departments. Nurs Manage 2005 Sep;36(9):46-53.

270. Moore KM, Edgar BL, McGuinness D. Implementation of an automated, real-time public health surveillance system linking emergency departments and health units: rationale and methodology. CJEM 2008 Mar;10(2):114-9.

271. McKay JI. Building the emergency department of the future: philosophical, operational, and physical dimensions. Nurs Clin North Am 2002 Mar;37(1):111-22, vii.

272. Revere D, Nelson K, Thiede H, Duchin J, Stergachis A, Baseman J. Public Health Emergency Preparedness and Response Communications with Health Care Providers: A Literature Review. BMC Public Health 2011;11:337.

273. Uckay I, Sax H, Longet-Di PS, Baur H, Boulc'h MF, Akakpo C, et al. Cockroaches (Ectobius vittiventris) in an Intensive Care Unit, Switzerland. Emerg Infect Dis 2009 Mar;15(3):496-7.

274. Cotton MF, Wasserman E, Pieper CH, Theron DC, van TD, Campbell G, et al. Invasive disease due to extended spectrum beta-lactamase-producing Klebsiella pneumoniae in a neonatal unit: the possible role of cockroaches. J Hosp Infect 2000 Jan;44(1):13-7.

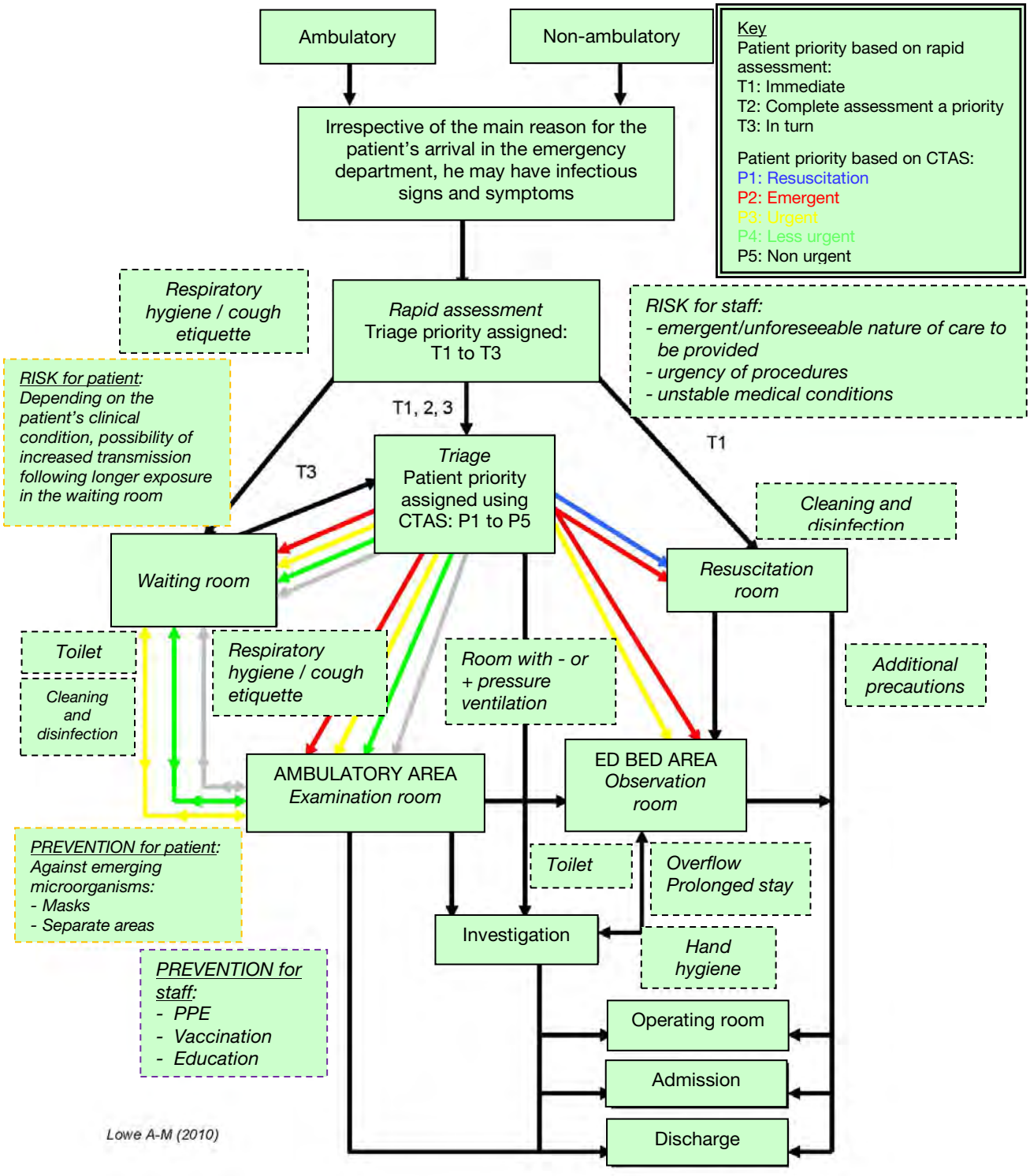
275. (Unknown author). Bats found flying about hospital. BBC News 2009 October 8 [cited 2012 Aug 15]; URL: http://news.bbc.co.uk/2/hi/uk_news/scotland/tayside_and_central/8296985.stm.

276. Martha Sellers. Bat colony forces NC hospital to send patients elsewhere. WorldNow WBTV 2012 February 18 [cited 2012 Aug 15]; URL: http://www.wbtv.com/story/16966164/bat-colony.

Appendix 1

A patient's pathway through the emergency department and various aspects of IPC

Figure 4 **A Patient's Pathway through the Emergency Department and Various Aspects of IPC**



Appendix 2

Hierarchy of IPC controls

Table 3 Hierarchy of IPC Controls

Level	Characteristics
Engineering Controls	These include the physical design and infrastructure of a health care facility, such as the layout of rooms and washrooms, sanitary systems, patient care areas, ventilation systems, etc. These controls are permanent and their effectiveness does not depend on individual practices. In the hierarchy of controls, they provide the necessary basis for implementing policies and procedures. For example, a hand hygiene policy requires an adequate number of conveniently located sinks and alcohol-based hand rub (ABHR) dispensers. These controls provide the most effective protection.
Administrative Controls	These include all the policies and procedures that must be implemented to prevent exposure to or transmission of microorganisms to a susceptible host, such as a hand hygiene policy, respiratory hygiene / cough etiquette, the detection of contagious cases, isolation, cleaning and disinfection, immunization, continuous quality improvement in IPC, etc. These controls provide a foundation for ensuring that all personnel, patients and visitors adopt appropriate behaviours. To be effective, the compliance of the various people concerned is required along with the necessary resources to implement the controls (engineering controls). They must be implemented rapidly to prevent transmission and manage outbreaks. Their effectiveness depends on individual practices.
Personal Protective Equipment (PPE)	PPE includes eye protection, gloves, gowns, visors, masks and respirators. The health care organization must ensure the availability and appropriate use of PPE by health care personnel, patients and visitors. The effectiveness of PPE depends on its appropriate use by people who are educated and well informed. Compliance varies depending on knowledge and personal beliefs as well as work organization. These controls are the weakest tier in the hierarchy of controls.

Appendix 3

Rating categories for recommendations

Table 4 Rating Categories for Recommendations

Rating Category	Definitions of Rating Categories Attributed to CINQ Recommendations
1A	**Recommended** Measure based on moderate - to high-quality evidence and/or expert consensus disseminated by internationally recognized organizations.
1B	**Recommended** Measure based on low-quality evidence and/or an accepted practice supported by a theoretical rationale.
1C	**Recommended** Measure based on legislation, government directives or recommendations resulting from the work of government advisory committees other than the CINQ or based on the guidelines of accreditation bodies.
2	**Suggested** Measure selected despite the lack of evidence whose contribution to preventing the transmission of pathogens remains undetermined.
3	**Unresolved** No consensus. Potential avenue for research.

Publication N°: 1965

Centre d'expertise
et de référence

www.inspq.qc.ca

Institut national
de santé publique
Québec