Taking Action for Safe and Healthy Clinical Facilities: Analysis of Risk Factors in the Prevention of Nosocomial Infections

Part 1: Nosocomial Infections

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It seems that the risk of developing an infection after a visit to the hospital is greater than the risk of having a car accident. This comparison may seem exaggerated; however, nosocomial infections, rarely a subject of discussion, have, over the years, wreaked far more havoc, suffering and death in our hospitals than commonly thought.¹

One is tempted to think that drastic changes have been implemented, especially as no serious epidemic has been reported lately. However, in spite of Bill 113, adopted on December 19, 2002, which modified the Health Care and Social Services Act, the incidence of nosocomial infections among hospitalized patients remains at 11%.² In many European countries, that rate is down to 5 to 7%, and even below that in others.³

In an era of cutting-edge care, it is a sad state of affairs that 9.8 to 11% of patients hospitalized in Quebec will catch a nosocomial infection during their stay. An even more disturbing fact is that 3,000 to 4,500 deaths occur as a result every year. On a larger scale, “between August 2004 and August 2007, 14,941 patients suffered a C. difficile nosocomial infection in 94 acute care hospitals in Quebec. The exact number of deaths remains unknown as the existing monitoring system of this infection does not allow us to keep track of it.”⁴

The Comité provincial sur les infections nosocomiales du Québec (CINQ) has clarified some points. “Based on data from U.S. studies, 10% of admissions into short-term care hospitals result in nosocomial infection acquisition. If day surgeries are added to the number of admissions, there may be between 80,000 to 90,000 nosocomial infections per year with a probable mortality rate in the range of 1 to 10% depending on the type of infection. Nosocomial infections are therefore a serious phenomenon.”⁵

Risk management: from prevention to response

Awareness of this vulnerability led to the implementation of an assurance concept – risk management. In health care, risk management is a preventive method in which a variety of other methods are implemented to alleviate or eliminate risk (i.e., situations which can result in damage to facilities or harm to staff and users). Risk management in health care is a complex task which requires up-to-date knowledge of government directives in prevention matters (i.e., Bill 113, Francoeur report, etc.). It also requires sound knowledge of the health care environment, professions, work habits, clientele, and equipment as well as of weaknesses or vulnerabilities in order to remedy them.

In addition, risk management professionals must have knowledge of multiple fields - including medicine, bacteriology, pharmacology, and epidemiology - and be able to work in synergy with teams of other highly qualified professionals. Risk management involves planning interventions and customized training by occupation; making interveners known to their peers, patients and visitors; enforcing the necessary measures, directives and recalls; performing outcome assessments; and implementing corrective measures whenever necessary. A complete explanation of risk management is impossible without a discussion of the patients (and their families) who have suffered a preventable infection or an accident, as well as the measures which could have been implemented to alleviate or eliminate such incidents.

Multiple risks

The numbers above may seem staggering, but they only deal with infections. There are many other risks in hospitals which can adversely affect patients and their families. Leading the list with infections are accidents related to falls or the use of restraints. In addition, there are idiosyncratic reactions to medications, transfusion complications, medication errors, and omissions to provide treatment or medication. Furthermore, there are risks associated with

1. Risk Management: Definitions

Risk defines a more-or-less predictable threat and encompasses the probability or likelihood of its occurrence.

Risk management, a term used in assurance, calls upon a variety of preventive measures and methods to limit or eliminate the risk of occurrence of an accident or incident and to contain any outcome whenever the said accident or incident materializes.


2. Risk Management

Managing risks involves:

- Identifying potential risks in a clinical setting;
- Preventing foreseen risks;
- Taking into consideration the effect of the materialization of risks on the patient, his family and on attending staff;
- Limiting the consequences or losses arising from the materialization of a risk.

sterilization; with malfunctioning technical, radiological, electrical or electronic equipment; and with break-downs of kitchen refrigeration equipment which need to be taken into consideration. Compounded with this are the environmental risks associated with biological waste management. Therefore, risk management must be implemented as part of a global safety initiative in all hospital departments.

3 – Nosocomial Infection

Definition

- Infection: invasion of the body by a micro-organism (bacterium, virus, fungus, parasite) capable of multiplying and inducing tissue damage and disease.

- Nosocomial: from the Greek nosos (disease) and nosokomeon (hospital) which qualifies that which is caught in such an environment.

Nosocomial infections: a definition

It is well known that an infection is an invasion of the body by a pathogenic microorganism capable of multiplication, specifically a bacterium, a virus, a fungus or a parasite. The term infestation is often used when a non-microbial parasite invades and attacks the body.

The term nosocomial is from the Greek nosos, which means disease, and nosokomeon, which means hospital. Nosocomial refers to that which is contracted during a hospital stay or in a medical environment. This definition may surprise users who visit hospitals to receive treatment, not to get infected. An endogenous nosocomial infection is acquired from a source within the body of the patient, whereas an exogenous nosocomial infection is transmitted from one patient to another, from staff to patient, or simply through a pathogen that is present in the hospital environment.

In order to be classified as nosocomial, an infection must meet specific criteria:

- It was not present when the patient was admitted.

- It must be declared more than 48 hours after the patient was admitted or beyond the incubation period of the infection when it is known to be present.

- Infections which occur within the 30 days following surgery are classified as nosocomial in cases of infected surgical wounds.

4 – An Infection Is Considered Nosocomial When:

- It was not present when the patient was admitted;
- It is declared more than 48 hours after the patient is admitted.
- It is declared beyond the incubation period when the latter is known.
- It is declared within the 30 days following surgery (for surgical wounds).
- It occurs within the year following an implant or prosthesis procedure.

An infection may be classified as nosocomial within the year following an implant or prosthesis procedure.

These infections may be secondary (or not) to invasive treatment.⁷

Main types of nosocomial infections and their outcomes

Nosocomial diseases are common and caused by a variety of pathogenic agents. They wreak considerable havoc and are the cause of numerous deaths.

“[In Quebec], the number of deaths attributed to nosocomial infections is fourth after strokes, vascular diseases and cancers,” said Ms. Lise Andrée Galarneau, chair of the Comité de surveillance de la résistance bactérienne du Québec (Quebec bacterial resistance monitoring committee). "The only difference is that nosocomial infections are caught in hospitals and since patients die in hospitals, it seems normal."⁸

She adds that this worrisome phenomenon is the object of little discussion. “We refer to it as the silent epidemic. Because nosocomial infections are not often discussed in the media and do not receive substantial coverage like traffic accidents, people do not talk about them.”⁹

According to the Comité d’examen sur la prévention et le contrôle des infections nosocomiales (examination committee for the prevention and control of nosocomial infections and hospital infections), "the most frequent [nosocomial infections] are urinary infections, the majority of which arise from the use of urinary catheters. Such infections prolong hospital stays by 4 to 16 days. Pneumonias caused by prolonged immobility or mechanical ventilation can be associated with a death rate of 7%. Infections of surgical sites, primary nosocomial bacteraemia (mainly those caused by the installation of a catheter), and diarrhea associated with Clostridium difficile also have an incidence on the mortality, morbidity and quality of life of those affected. They also increase the duration of hospital stays and, as a result, reduce accessibility to care and services for other patients. Other nosocomial infections include infections of the skin and soft tissues, viral gastroenteritis, influenza (flu), other respiratory viruses, and infections of the nose, eyes, throat, and ears."¹⁰

Clostridium difficile

An outbreak of Clostridium difficile alarmed the population in 2003 and 2004 when the number of cases reported in hospitals increased dramatically, remarkably so in certain regions and in specific hospitals. According to a report by the Réseau de l’Information de Radio-Canada (RDI) aired on October 21, 2004, "[OUR TRANSLATION] Clostridium difficile appears to have spread to the Montérégie (South Shore), to Montreal and to other regions of Quebec. Since 2003, 7,000

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⁹Web explorateur MedÉcho is an online tool available in French only which is used to retrieve data on hospitalizations in Quebec.
persons have been infected. That is four times more cases reported than in previous years. Furthermore, 600 people died in just eight hospitals in Montreal.¹¹

Since the report aired, Clostridium difficile is being monitored closely and the number of infections has dropped. Improvements have been made; however, C. difficile infections remain of great concern.

**Old bacterium, same virulence**

Clostridium difficile is a spore-forming anaerobic, Gram-positive bacillus of the genus Clostridium which was first identified in 1935. It was labelled difficile because researchers had a hard time isolating it, not because of the problems it causes. It is the leading cause among adults of infectious nosocomial diarrhea. The consumption of antibiotics often contributes to the spread of the C. difficile bacterium in the organism.

A change in the intestinal flora is essential to the spread of this bacterium. Antibiotics reduce the count of normal bacteria in the intestine and encourage the multiplication of this bacillus, which secretes a toxin responsible for diarrhea. The usage of proton pump inhibitors also encourages the spread of C. difficile by suppressing gastric acid production. The resulting hypo acidity may expose a weakened body to intestinal infections.¹² C. difficile is transmitted from person to person by feco-oral or hand-to-hand contact (manuportage). It can also be transmitted in a contaminated environment.¹³

Since 2003, a particularly virulent and antibiotic-resistant strain of C. difficile has been responsible for severe nosocomial infections and epidemics which may cause severe injury or death. During complications, the death rate may reach 35% to 50%.¹⁴ ¹⁵

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Many nations are affected by this epidemic. Up to 5% of the population may be carrying this bacterium in their intestines without experiencing any health problems or requiring any treatment. C. difficile spores have also been found on the ground, in soil, in animal feces, on vegetables, in uncooked meat, in homes, and in the water of rivers, pools and lakes. “The bacterium is present in the stools of over half of children under 2 years old and in 5% of healthy adults. Healthy people rarely develop symptoms of C. difficile infection because other bacteria normally present in the intestine prevent C. difficile germs from multiplying.”

C. difficile can survive on a variety of surfaces, in particular in hospitals, on objects such as: flush handles, faucets, door knobs, bed rails, toilet seats, bedpans, thermometers, sphymanometer cuffs, diaphragms, stethoscopes, otoscopes, and so on. The risk of contagion increases when more than one person uses a toilet bowl. Some hospital departments are more affected than others, in particular intensive care, hematology, geriatrics, medicine and surgery. Children, seniors, patients with compromised immune systems, patients undergoing

### 7 – Comparison of C. difficile cases in 2003-2004 and 2005-2006

<table>
<thead>
<tr>
<th>Variable</th>
<th>Year 1 08/22/2004 – 09/20/2005</th>
<th>Year 2 08/21/2005 – 08/19/2006</th>
<th>Evolution</th>
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<tr>
<td>Cases</td>
<td>3,660</td>
<td>2,266</td>
<td>- 38%</td>
</tr>
<tr>
<td>Principle cause of death</td>
<td>134 (4%)</td>
<td>56 (2%)</td>
<td>- 58%</td>
</tr>
<tr>
<td>Contributing cause of death</td>
<td>177 (5%)</td>
<td>79 (3%)</td>
<td>- 55%</td>
</tr>
<tr>
<td>Colectomy</td>
<td>33 (1%)</td>
<td>23 (1%)</td>
<td>- 30%</td>
</tr>
<tr>
<td>Readmission</td>
<td>243 (7%)</td>
<td>135 (6%)</td>
<td>- 44%</td>
</tr>
<tr>
<td>ICU Adm.</td>
<td>89 (2%)</td>
<td>47 (2%)</td>
<td>- 47%</td>
</tr>
</tbody>
</table>

Translated from Programme de caractérisation des souches de C. difficile, available at: [link](http://www.msss.gouv.qc.ca/sujets/prob_sante/nosocomiales/download.php?f=a835ef6abeef61ead23373491db7210c#299.18)

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chimotherapy or antibiotic treatment, and patients who have just received a transplant may experience severe complications.

“C. difficile infections can cause wide ranging symptoms from light to severe diarrhea accompanied by fever, abdominal pain and bloating. More rarely, blood may be found in the stools and the colon may undergo severe inflammation.”\(^\text{18}\) The most severe complications are septic shock, kidney failure and toxic megacolon, characterized by massive colonic dilation which can lead to perforation or death.\(^\text{19}\) According to estimates made in 1994, approximately 2% of patients suffering from \(C.\) difficile colitis will die as a result of associated complications.\(^\text{20}\)

**Vancomycin-resistant enterococcus (VRE) infections**

Vancomycin-resistant \(enterococci\) (VRE) are a group of bacteria of the \(enterococcus\) genus normally found in the human intestine. Generally \(enterococci\) do not provoke infections among healthy individuals; however, they may occasionally cause urinary infections, infections in wounds, and blood infections. The latter are considered nosocomial infections when acquired during a stay in the hospital. VREs are characterized as having developed resistance to various antibiotics, including vancomycin. VREs do not provoke more infections than other \(enterococci\), but they do limit the choice of antibiotic therapy and may require an extended hospital stay as well as longer, more difficult treatment.\(^\text{21} \)\(^\text{22}\) The consequences of resistance are serious and are marked by a greater probability of infectious relapse, an increase in the duration of hospital stays and costs, and higher death rates. According to studies, mortality attributable to vancomycin resistance may range from 17 to 30%\(^\text{23}\).

**VRE transmission**

VRE is normally transmitted from person to person through direct contact with the stools, urine or blood of a carrier or through contact with the infected hands of a health care employee. Contamination occurs when care is being provided or

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when certain contaminated objects are touched, in particular toilet bowls, door knobs, switches, bed rails, stethoscopes, otoscopes, and so on. The most effective method to avoid spreading VRE is for caregivers and patients to wash their hands. VRE cannot be spread through airborne transmission such as sneezing and coughing; however, VRE can remain present for up to seven days on a contaminated surface, which can become a vector of transmission.\textsuperscript{24}

**Manifestation**

*Enterocci* are intestinal bacteria, but a VRE infection can invade other parts of the body and spread in its tissues. Symptoms will vary according to the area infected. Symptoms such as fever, inflammation, redness, infection of wounds, urinary infection and pneumonia may appear. Any prolonged hospital stay is a significant risk factor for VRE contamination. Persons with compromised immune systems, who are seriously ill, who have serious medical problems such as diabetes, who have surgical wounds, who have undergone extended antibiotic treatment, who are undergoing dialysis, and who are hooked up to invasive devices (i.e., a central catheter, a tracheotomy) are at greater risk of developing a VRE infection.

**MRSA and MRSO: infections to monitor**

Methicillin-resistant *Staphylococcus aureus* (MRSA) and oxacillin-resistant *Staphylococcus aureus* (ORSA) are bacteria which live outdoors. These bacteria are commensal, meaning that they are normally found among humans and may colonize the skin or mucus (in particular in the nose) but do not cause serious infectious among healthy individuals. *Staphylococcus aureus* (also known as *golden staph*) is the most dangerous form and is responsible for numerous infections, in particular its MRSA form, which continues to cause a growing number of hospital-related infections. Because of its resistance to oxacillin, the ORSM strain of *Staphylococcus aureus* is also wreaking havoc. Even though they are not more infectious than other *staphylococci*, both MRSA and ORSA limit antibiotic therapy options.\textsuperscript{25}

“[OUR TRANSLATION] MRSA has considerable repercussions on hospital users. The treatment of MRSA-infected patients is complex because therapeutic options are limited. Preventing and controlling the spread of MRSA in a health care environment requires the enforcement of extremely strict measures such as: identifying patients who are carriers upon admission or during their stay; providing private rooms or collective rooms to carriers; having attending health care staff wear gloves and gowns. Treatment is expensive and markedly increases the duration of any hospital stay.”\textsuperscript{26} One of the problems of *staphylococcus* is its great plasticity which is associated with the constant evolution of its epidemiological characteristics. In the past 30 years of its evolution, it has developed a variety of attributes: from being vancomycin resistant, it has evolved since 2000 to multi-resistant to penicillins, cephalosporins, and so on.\textsuperscript{27}

Among hospitalized patients contaminated with MRSA, “[OUR TRANSLATION] all organs and tissues can be affected. The most serious infections include blood infections (bacteremia) among


patients who have been inserted with a central venous catheter, pneumonias among patients receiving assisted breathing, as well as infections of surgical sites and of the bones and joints. Osteomyelitis is especially difficult to treat and patients suffering from it often relapse.\(^\text{28}\)

Furthermore, community-associated MRSA (CA-MRSA) strains have emerged and are expressed through skin infections "[OUR TRANSLATION] in the form of pimples and boils. CA-MRSA is often misdiagnosed as a simple insect bite. This infection is a rash accompanied by swelling, pain and pus discharge. (...) If the skin lesions are not treated immediately, the infection can spread to soft tissues and result in: abscess, cellulitis, myositis (inflammation of muscle tissue). The infection can also spread to other tissues and organs. Certain strains of CA-MRSA produce extremely virulent PVL cytotoxins (Panton-Valentine leukocidin). PVL destroys leukocytes (white blood cells), induces toxic shock, and/or necrotizes tissues, in particular the lungs, which results in death within a few days in 50% of cases."\(^\text{29}\)

**How is MRSA transmitted?**

Like many other nosocomial pathogens, MRSA is mainly transmitted patient-to-patient or caregiver-to-patient through hand-to-hand contact - an excellent reason to encourage hand washing as the most effective preventive measure. MRSA can be found in the blood of infected patients. Health care professionals must wear gloves, masks and gowns when there is a risk of contact with organic fluids. MRSA can also survive in the nostrils or on a lesion for months, even years.\(^\text{30}\)

Up to 50% of healthy individuals are colonized by *staphylococci*, regardless of whether the strain is resistant or not to antibiotics. The bacteria can be found in the nasal cavity, throat, perineum, and, in low quantities, in the digestive tract. Healthy carriers of MRSA propagate the bacteria on their clothes, in hospitals and in the community, which become potential sources of nosocomial infections. In 2005-2006, 61% of patients at Hôpital Le Gardeur located in the suburbs of Montreal were colonized with MRSA upon admission.\(^\text{31}\) The bacteria were spread throughout the hospital in particular by attending staff who came into contact with colonized patients. After just a single contact with the patient and/or his environment, more than 60% of the hands and the clothes of employees had been contaminated with MRSA.\(^\text{32}\) That alone should be a source of concern.

**Beta-lactamase producing Enterobacteria**


\(^\text{32}\) Ibid.
Extended-spectrum beta-lactamase (ESBL) has developed a strong resistance to antibiotics. It originates from the opportunistic Escherichia coli (E. coli) and Klebsiella pneumoniae bacteria. These bacteria are usually harmless among healthy individuals; however, they can cause serious complications to those with compromised immune systems. Other enterobacteria can also produce ESBL, in particular salmonellas, Proteus mirabilis and Pseudomonas aeruginosa, E. coli is normally found in human and warm-blooded animal feces. This bacterium belongs to the coliform bacterial group, which can cause various types of intestinal infections.33

There are many strains of E. coli. The best known are those which cause food poisoning and bladder infections. The latter are usually endogenous, meaning that they originate within the individual or following the insertion of a contaminated catheter. E. coli bacteria can become resistant to antibiotics and consequently difficult to treat, especially when they provoke septicemia, meningitis or an infection of a wound. E. coli can survive for days on surfaces such as bed rails, bed pans, toilet seats, and so on. Strict hygiene measures must be enforced to avoid spreading E. coli.

Acinetobacter baumannii

There are many strains of Acinetobacter baumannii. A coccobacillus bacterium, is an opportunistic pathogen which mainly thrives in soil, water, vegetables, and on the healthy skin of humans and animals. Strains of Acinetobacter are frequently isolated in septic sludge and waste water. “[OUR TRANSLATION] Acinetobacters belong to the normal skin flora and are frequently isolated in the humid areas of the body (groin, axilla, interdigital spaces) as well as in the mouth, throat, trachea, nose, conjunctiva, urethra and rectum. There are many strains of acinetobacter.”34

The Acinetobacter baumannii coccobacillus occasionally causes sporadic nosocomial infections and is occasionally epidemic prone. The most commonly detected infections are pulmonary (especially among intubated and ventilated patients in reanimation with an overall mortality ranging from 40% to 70%), septicemia, wound infections, and urinary tract infections. Hand-to-hand contact by attending staff and the aeration of contaminated equipment (i.e., humidifier, ventilation equipment) are the most common transmission methods.35

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“[OUR TRANSLATION] This bacterium is often found in hospitals, in humid or moist areas (i.e., sinks, soaps, distilled water, the water of humidifiers). It is also capable of resisting certain quaternary ammonium-based disinfectants and of proliferating in disinfectant recipients. This bacterium also has the particularity of being capable of surviving for a prolonged period (more than 8 days) in a dry environment (i.e., soil, surfaces, clothes, and linen). Unlike other acinetobacters, *A. baumannii* is rarely isolated on the skin; however, it is sometimes isolated in an asymptomatic state on the oropharynx or rectum of hospitalized patients.”36

“[OUR TRANSLATION] *A. baumannii* infections in particular affect elderly and immuno-compromised patients who undergo prolonged hospital stays in reanimation units. The usual risk factors include exposure to long-term invasive procedures (intubation and assisted breathing), surgery and prior antibiotic therapy. (…) Another strain, *Acinetobacter ursingii*, affects hospitalized patients suffering from severe infections such as septicemia. Certain cases have led to the hypothesis that these strains are capable of spreading within hospital departments. 37 38

Acinetobacters are responsible for nosocomial infections, especially among weakened patients who have suffered multiple trauma or cancer, or who have compromised immune systems. These bacteria are also responsible for septicemia, meningitis, endocarditis, suppuration (abscess of the brain, lungs or thyroids; superinfection of trauma- or surgically induced lesions; lesion discharges of the eye), pneumopathies, and urinary infections.39

“Acinetobacters are responsible for approximately 10% of all nosocomial infections. Their high level of antibiotic resistance makes it extremely difficult to treat patients.

They are found on attending staff, outdoors and indoors on ventilation systems, sink traps, valves, mattresses, damp clothes and linen, the bedroom appliances of patients, and medical equipment. The bacteria can survive on inert material and in contaminated dust for more than eight days. Reanimation and invasive methods (intubation, installation of a catheter) encourage their dissemination.”

39. Ibid.
Why is there an increase in nosocomial diseases?

Many hypotheses have been formulated to explain the growing number of nosocomial infections since 2000, including: obsolete hospital infrastructures, lack of private rooms for infected patients, lack of sanitary facilities, lack of nursing and janitorial resources, the equipment made available to all users and staff members, the reuse of single-use equipment, the administration of certain classes of antibiotics, and so on. The overall condition of the patient is the single greatest risk factor: his age, physical condition, his trauma or disease, his compromised immune system, his organ transplant, and the antibiotics which he consumes.

These risk factors, although not negligible, are usually controllable and preventable (as illustrated in figures 8 and 9). All aspects which concern hygiene play a critical role. The pathogenic agents at the origin of nosocomial infections differ in their essence, but share common attributes when it comes to prevention. Practically all measures aimed at combating nosocomial infections can be effective.

Methods to combat nosocomial infections

Nosocomial infections can be transmitted through a variety of methods; however, as humorist Philippe Geluck noted, “prevention is transmitted through the mouth, eyes and ears,” meaning by informing and educating both the population and health care workers. Convincing individuals through the dissemination of information to enforce proper personal hygiene and to disinfect hospital facilities and equipment will help to control the spread of nosocomial diseases.40

Reportable diseases

Making it mandatory to report certain diseases is one of the measures implemented to prevent nosocomial infections and to raise alertness among health care workers. This public health initiative was adopted to monitor certain infections, to study the sources of their outbreak and to contain them. The object of the Public Health Act (R.S.Q., chapter S-2.2) and its corresponding regulations is to protect the population, to prevent diseases, and to control their outbreak and to monitor their evolution.41 A reportable disease is any health problem which is “likely to cause an epidemic if it is not controlled.” A reportable disease is any infection which:

- Is recognized as a serious health threat;
- Requires vigilance on the part of public health authorities or an epidemiological investigation;
- Is preventable or controllable through the actions of public health authorities or other authorities [OUR TRANSLATION].”

“[OUR TRANSLATION] The Minister's Regulation under the Public Health Act provides for a list of intoxications, infections and diseases which must be reported to public health authorities, as well as the written report which must be transmitted.”

“Among the reportable diseases included in the list are a few nosocomial infections such Vancomycin-resistant *enterococci* and Methillicin-resistant *Staphylococcus aureus* (MRSA).”

**Enforcement of basic hygiene procedures**

Staff and users must constantly be reminded of the importance of hand washing. Patients can even request that attending staff wash their hands before touching them because this is a basic preventive method. Hands can be washed with soap and water or with a 60% hydro-alcohol solution. Employees must provide the necessary supplies to the patient before his meals, after he goes to the bathroom, after he coughs or sneezes, and when his hands are dirty. The same rules apply to attending personnel. To this is compounded the need for intensive cleansing after accidental exposure to blood or other biological fluids and after manipulating any contaminated object. The cleansers must have the right concentrations in order to be effective. Emphasizing this point is not a waste of time. Some may be tempted to save quantities of the active substance for economic or environmental reasons. The figure herein illustrates government of Quebec recommendations for hand washing. Figure 11 indicates the characteristics of the potentially usable substances.

Attending staff must see to it that the patient receives proper hygiene and that his skin lesions are cleansed, disinfected and properly dressed. Any suspicious wound should be reported to the physician. Workplace hygiene is essential. Bacteria which cause nosocomial infections can be found on a variety of surfaces, in
particular on bed rails, door knobs, switches, bedpans, otoscopes, thermometers, tensiometers, toilet seats, hospital gowns, the clothes of staff members, and so on. Depending on the strain involved, these bacteria can remain a potential threat as a result of their ability to survive for varying periods.

### Antimicrobial spectrum and characteristics of hand-hygiene antiseptic agents

<table>
<thead>
<tr>
<th></th>
<th>Gram-positive bacteria</th>
<th>Gram-negative bacteria</th>
<th>Mycobacteria</th>
<th>Fungi</th>
<th>Viruses</th>
<th>Speed of action</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohols</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>Fast</td>
<td>Optimum concentration 60-90%; non-persistent activity</td>
</tr>
<tr>
<td>Chlorhexidine (2% and 4% aqueous)</td>
<td>+++</td>
<td>++</td>
<td>+</td>
<td>+</td>
<td>+++</td>
<td>Intermediate</td>
<td>Persistent activity; rare allergic reactions</td>
</tr>
<tr>
<td>Iodine compounds</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>++</td>
<td>+++</td>
<td>Intermediary</td>
<td>Causes skin burns; usually too irritating for hand hygiene</td>
</tr>
<tr>
<td>Iodophors</td>
<td>+++</td>
<td>+++</td>
<td>+</td>
<td>++</td>
<td>++</td>
<td>Intermediate</td>
<td>Less irritating than iodine; acceptance varies</td>
</tr>
<tr>
<td>Phenol derivatives</td>
<td>+++</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Intermediate</td>
<td>Activity neutralised by non-ionic surfactants</td>
</tr>
<tr>
<td>Triclosan</td>
<td>+++</td>
<td>++</td>
<td>+</td>
<td>-</td>
<td>+++</td>
<td>Intermediate</td>
<td>Acceptability on hands varies</td>
</tr>
<tr>
<td>Quaternary ammonium compounds</td>
<td>+</td>
<td>++</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>Used in combination with alcohols; ecologic concerns</td>
<td></td>
</tr>
</tbody>
</table>

Activity: +++ excellent; ++ good, does not include the entire bacterial spectrum; + fair; - no activity or not sufficient.  

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The bandages and contaminated material must be disposed of in a sealed plastic bag placed in a specifically designated recipient. Some pathogenic agents live in moist areas such as baths, showers and faucets. Rigorous disinfection is an absolutely necessary condition for effective prevention.46

Other necessary measures

In addition to basic hygiene, other preventive measures need to be enforced. First, any suspicious symptom must be reported immediately so that screening may be conducted swiftly. This is the most effective containment method. Isolating individually or collectively contaminated patients in a predetermined area is also necessary. In some cases, in particular for MRSA and influenza, staff and visitors should be required to wear gowns and gloves. A card should be clearly and visibly posted on the door of the patient to indicate that there is a risk of contamination for staff and relatives. The card should also state which measures need to be taken.

If contamination is confirmed, all contents of the room must not be reused before first being cleansed or disinfected. Stretchers, wheelchairs and chairs must be disinfected. Lotions, creams and a variety of other substances and materials available to all must be avoided. Stockpiles of linen and instruments in the room must be maintained at minimal levels. Carts used to carry medical equipment must also undergo regular maintenance in order to minimize risk. Blood-pressure cuffs should be vaporized after single-patient use.47

Hand sanitizer and disposable tissues should be made readily available for patients, staff and visitors.

Traceability

The identification of risks and their sources is essential in an infection prevention system. A maintenance tracking system must be implemented to understand the events leading to contamination and to encourage staff to adhere to prevention and safety guidelines. Traceability

<table>
<thead>
<tr>
<th>Parameters associated with care providers</th>
<th>Reason reported</th>
<th>Documented risk factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Didn’t think/forgot about it.&quot;</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Interference in care giver-patient relationship</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Needs of patients considered a priority</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Believe that gloves releases them from washing hands</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Lack of scientific evidence on the impact of hand hygiene on infection rates</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Scepticism regarding its efficacy</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Absence or a role model (i.e., a superior)</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Skin damaged/rash</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

2 – Risk Factors and Reasons for Lack of Adherence to Hand Hygiene


invokes the accountability and responsibility of interveners. When health, well-being and lives are at stake, tracking takes on a new light. It is necessary to implement a system which tracks the chain of events leading to an infectious outbreak and its source. Basically, such a system consists of a checklist on which a date, time and signature are apposed by the person responsible for maintenance, disinfection and sterilization of equipment. This list must be posted in the room, in bathrooms and on medical equipment carts. The section of the record indicating prescriptions, reports, the therapeutic nursing plan, and observation reports should remain at the nursing station. The section providing daily information such as temperature, blood pressure and so on should be posted in the room.48

**Anti-microbial clothing: an innovative technology**

Antimicrobial clothing - which has undergone a special treatment to give it its properties – can be added to the preventive arsenal. Such clothing protects the person wearing it from pathogenic agents (bacteria, viruses, fungi). The clothing even attacks H5N1. The active substance of the clothing is a biocide which is applied to make the tissue permanent and resistant to washing. It received a patent from the Canadian Health Products and Food Branch (HPBF).

“[OUR TRANSLATION] According to Dr. Jean Barbeau, a microbiologist at the Université de Montréal, tests conducted on these uniforms have shown that the tissue is capable of stopping the growth of micro-organisms.”49 50

“[OUR TRANSLATION] The issue of workplace uniform contamination is a topic which often receives little exposure in infection control programs,” he said. “The scientific literature on the subject is disappointingly scant. And yet it is well documented that a huge variety of pathogenic micro-organisms are found on the clothes of nurses who as part of their duties must move constantly about from patient to patient and room to room, including the operating

**13 – Different types of vigilance**

- Infectious vigilance
- Hemovigilance
- Medical device vigilance
- Radiation protection
- Reactive vigilance
- Biomonitoring
- Pharmacovigilance (PV)
- Anesthetic safety
- Body fluid safety

Translated from Institut Curie. La gestion des risques. La coordination des vigilances, available at: http://www.curie.fr/hopital/presentation/organisation/gest_risq.cfm/lang/_fr.htm


50. Dr. Jean Barbeau is a professor at the faculty of medicine and dentistry of the Université de Montréal, where he teaches immunology and microbiology. He is also the director of the research laboratory on infections control.
room. As the textiles of their clothing do not contain the natural anti-bacterial properties of the skin, many germs may end up surviving for a greater length of time on clothing.”51

“ Their survival encourages their transmission through hand-to-hand contact or to areas which are far from desirable. Our tests have shown beyond any doubt that when a heavy bacterial load (i.e., *Staphylococcus aureus*, *Pseudomonas aeruginosa*) is vaporized, the fabric eliminates practically all contaminants in less than 30 minutes.”52

Uniforms which have undergone this treatment were developed in the laboratories of Stedfast in Granby, Quebec. The antimicrobial clothing is manufactured entirely in Quebec by Protec-Style, a firm based in Saint-Jean-sur-Richelieu, and its various styles were conceived by Mr. Jean-Claude Poitras, a renowned Quebec designer. The clothing can be purchased by any person or firm that needs it to manage contamination risk.

The clothing is not intended exclusively for nurses. The items on sale include lab coats and socks which use the same technology. These should be of interest to any professional who has direct contact with patients. At a time when nosocomial infections such as *C. difficile* and VRE are wreaking havoc and the World Health Organization (WHO) is raising its alert level for Influenza A (H1N1), the topic of protective clothing for attending health care workers should be a major concern.

**Infections surveillance**

The primary concern of hospital centres must be prevention. Nurses should also focus on prevention as one of their main goals because of its role in ensuring the safety of the care team. Hospital centres must position preventive measures at the heart of their general plans and policies as part of a larger, province-wide surveillance mechanism.53

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**14 – Bill 13 Creates the Obligation for Health Care Centres:**

- To ensure users the safe provision of health services and social services;
- To be informed, as soon as possible, of any accident having occurred in the provision of services that has actual or potential consequences for the user’s state of health or welfare;
- To monitor, to analyze and to report accidents and incidents;
- To establish adapted support and prevention measures;
- To create a risk management and quality assessment committee;
- To create a local register of accidents and incidents;
- To obtain hospital certification;
- To participate in the implementation of a provincial register of accidents and incidents for statistical purposes and to allow for Quebec-wide action.

**Bill 113 and the Francoeur Report**

Bill 113 recommends that what was stated in the previous paragraph be implemented in all health care and social services centres in Quebec in order to deliver safe care to users. In 2002, Bill 113

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52. Information can be found on these clothes ([www.protec-style.com](http://www.protec-style.com)).

laid the legal foundations for hospital risk management.\textsuperscript{54} It followed up on the recommendations of the Francoeur Report (2001), whose recommendations it enshrines.\textsuperscript{55} The spirit of the Act conformed to the concept of quality care, which has become the \textit{leitmotiv} of health care institutions in Quebec. Among the obligations outlined in the Act are the obligation to create a local risk management committee charged with ensuring user safety and reducing the incidence of problems associated with care delivery - whether infections or accidents - as well as the obligation to examine their causes and to come up with an appropriate intervention plan.

The Francoeur committee, which inspired Bill 113, noted that 15\% of all hospital accidents (infectious or other) were caused by individuals and that the remaining 85\% were caused by the system (organization, mechanisms, policies, procedures, and so on). That in itself justified that further attention be paid to the system.\textsuperscript{56}

\textbf{2006-2009 action plan to control and prevent nosocomial infections}

Following the adoption of Bill 113, the Ministère de la Santé et des services sociaux prepared an action plan which provided for the establishment of a provincial committee to track infections and risks which could endanger public health and to get an overall portrait of their incidence. This action plan gave directors of local programs further means to share knowledge, tools and orientations.\textsuperscript{57} Its directives are to protect patients during episodes of care - as well as staff, visitors, volunteers and caregivers - from multi-resistant infections or germs. The content of the provincial action plan covers the following six components:

- surveillance of nosocomial infections and vigilance towards emerging infections;
- policies, procedures and supportive measures;
- education and training;
- evaluation;
- communication and information;
- management of outbreaks.

“In addition to providing the health care and social services centres with various means to deal with nosocomial infections, the action plan enshrines the need to monitor and initiate cost-benefit analyses of preventing and controlling nosocomial diseases as well as to implement a system to evaluate their outcomes. One of the measures provides for the disclosure to the client of any accident (in this case infectious

\textbf{Nosocomial infections are accidents, within the meaning of the Act, of which at least a third are preventable.}


\textsuperscript{54}. Gouvernement du Québec. \textit{Loi modifiant la Loi sur les services de santé et les services sociaux concernant la prestation sécuritaire de services de santé et de services sociaux.} \url{http://www2.publicationsduquebec.gouv.qc.ca/dynamicSearch/telecharge.php?type=5&file=2002C71F.PDF}

\textsuperscript{55}. Ministère de la Santé et des services sociaux (2001, February). \textit{La gestion des risques, une priorité pour le réseau.} \url{http://publications.msss.gouv.qc.ca/acrobat/f/documentation/2000/00-915.pdf}

\textsuperscript{56}. Ministère de la Santé et des services sociaux (2001, February). \textit{La gestion des risques, une priorité pour le réseau.}

accident) which has occurred during the delivery of services of which he was the beneficiary and which may affect his health condition or well-being, as well as the implementation of measures to prevent future occurrences of the problem."

It is also recommended that staff have appropriate equipment, that they be sufficiently trained in infections prevention, that disinfection be carried out according to standards, and that a specified number of prevention nurses be assigned to each health centre.

The Québec Ombudsman noted that: “While in 2006-2007 nosocomial infections proliferated and reached worrisome levels in some institutions, the Québec Ombudsman (…) has noted that the ratio of infection control nurses to the number of beds is not respected in certain institutions. In principle, there should be one nurse per 100 beds in highly specialized care, one nurse per 133

15 - Application of evidence-based measures

The nurse meets the standard by:

1. adhering to appropriate hand hygiene protocols;
2. using a systematic approach to care (for example, nursing process) based on current infection control principles and research;
3. knowing her/his personal immunization status relevant to the practice setting and taking appropriate action to ensure client protection;
4. knowing the client’s immunization status relevant to the practice setting and taking appropriate action to ensure protection of clients, others and self (for example, information, referral, isolation, etc.);
5. taking all measures necessary to prevent the transmission of infection from the nurse to client(s) or other health care providers;
6. seeking advice from her/his primary health care provider regarding the potential for transmission to clients or other health care providers when the nurse has a potentially transmissible disease;
7. maintaining competence in infection control practices by accessing appropriate resources (for example, infection control practitioners, current research);
8. taking appropriate action when a co-worker has a potentially transmissible disease;
9. advocating for an environment and equipment that reduces the risk for disease transmission;
10. advocating for the establishment of and compliance with infection control policies relevant to the practice setting.

College of Nurses of Ontario. Infection Prevention and Control
http://www.cno.org/docs/prac/41002_infection.pdf

The primary role of nurses

Not all nosocomial infections are avoidable; however a prevention and control program must succeed in reducing the incidence of infectious outbreaks. To achieve this goal, the program must

be structured, deployed jointly and according to clearly established priorities which are adapted to both the existing and emerging contexts. Implementing such a program requires cooperation at all levels.60

In health care centres, the medical body, the physician in charge of the prevention committee and the nurse acting as a nosocomial infection prevention officer must all work together. The designated nurse may play a key surveillance role through her duties throughout all care units, by implementing recommendations and by educating staff under her supervision.

In 2008, the Ordre des Infirmières et infirmiers du Québec stated its position to this effect. On page 4, it is stated: “[OUR TRANSLATION] The OIIQ considers that the prevention and control of infections constitute a nursing duty regardless of the function or environment in which the nurse exercises her profession, and that the nurse must abide by this duty in every aspect and act of her profession. In addition, manager nurses and nurses who are members of the IPC team (infection prevention and control) must do everything within their means so that the institution can ensure the safe delivery of health care and health services to its clients. Nursing professors and educators as well as nursing trainee supervisors must prepare future nurses to fully assume their IPC duties.”61

The role of nurses in developing clinical and building master plan

As we have just seen, the functioning of staff and aspects of the clinical environment in which patients receive care play a role in the risk of nosocomial infections outbreaks. Many health care and social services institutions in Quebec must adopt a clinical and building master plan to establish organizational priorities over a 10-year horizon. This plan will serve as the select reference and decision-making tool for the building solutions deemed most appropriate to respond to the needs of patients.

16 – Problems to Anticipate in Implementing Effective Preventive Measures

- Persistent but obsolete preventive attitudes, habits and customs.
- Obsolete architecture of many older hospitals:
  - shared rooms;
  - common restrooms (toilets, sinks, tubs and showers).
- Nursing shortages.
- Insufficient maintenance workers and lack of preventive training.
- Delays in obtaining appropriate resources.
- Lack of employee awareness of the threat of infections to them and other patients.
- Insufficient attention paid to preventive method assessment in health care institutions.

For nurses and care managers, this plan is an excellent opportunity to highlight the elements of their practice which encourage responsible risk management by promoting the installation of care units in a manner which optimally limits the risk of nosocomial infectious outbreak. Any nurse who is aware of nosocomial risks must influence the organizational decisions of her institution to limit risk throughout the facilities.

**Individual prevention**

Infections prevention is important for both patients and nurses, because many of them become contaminated when touching infected patients. In the most severe cases, they may lose their careers or even their lives. Hand washing prevents nurses from contaminating themselves and their patients. This thought needs to be discussed in a context of work overload, the attending emergencies of patients and the greater tolerance for risk of certain professionals.

Nurses must realize that when it comes to prevention, they are bound to act ethically for their own sake and for that of their patients. The College of Nurses of Ontario provides guidelines on this subject which are shown in figures 16 and 17. They indicate that a nurse must undertake personal initiatives to prevent nosocomial diseases and to protect herself and thus her patients from them. The standards also show that all nurses must remain alert for potential accidents and must know how to react to them in case of doubt or if an actual accident occurs.

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**17 – Exercising professional judgement relevant to each client situation and infection prevention and control practices**

The Nurse:

- assessing situations for potential or actual infectious disease transmission;
- selecting and using the appropriate prevention measures when microorganisms are likely to come into contact with the nurse’s skin, mucous membranes or clothing;
- modifying his/her practice appropriately when there is a risk of transmitting a disease to clients or other health care providers;

- selecting, in collaboration with the health care team, the appropriate agency, manufacturer and government guidelines regarding the use and fit of personal protective equipment (PPE);
- advocating for change when agency, manufacturer or government guidelines do not meet infection control requirements regarding the appropriate use and fit of PPE.

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College of Nurses of Ontario. *Infection Prevention and Control*

http://www.cno.org/docs/prac/41002_infection.pdf
Conclusion

Zero risk is sadly not achievable when it comes to infections prevention in hospitals. When confronted with an infectious outbreak, nurses are obligated to reduce their incidence and to contain their potential consequences. Regardless of the corrective measures implemented, the risk of contamination always remains. Residual infections can re-emerge. That is why reducing the incidence of nosocomial infections is fundamental to health safety. Hospital research and operating statistics have shown the efficacy of simple measures such as hand washing before providing care and wearing gloves during invasive acts. By enforcing preventive measures when it comes to nosocomial infections, nurses on a day-to-day basis can have a positive effect in limiting the risk of clinical infectious outbreaks.

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