

Healthcare-Associated Infections as Patient Safety Indicators



INVITED ESSAY

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ABSTRACT

Healthcare-associated infections (HAIs) are a pressing and imminent patient safety concern as they cause substantial preventable morbidity and mortality. Despite this, there is a strong tendency for healthcare administrators and providers to view them as far less of a threat to patient safety than adverse events such as medication administration errors and falls. Further, validated strategies to prevent HAIs are frequently slow to be adopted.

This paper reviews two HAIs of increasing visibility and importance – namely, methicillin-resistant Staphylococcus aureus and Clostridium difficile – and discusses the pivotal importance of hand hygiene and environmental cleaning in their prevention. Possible reasons why HAIs are approached differently from other patient safety issues are discussed, including the false sense of security created by the advent of antibiotics, the lack of randomized controlled trials supporting infection-control interventions and the systemic multifactorial causes of HAIs that result in a need for interventions that go far beyond traditional clinical boundaries. Suggested strategies to improve patient safety with respect to HAIs are provided, including a focus on the role of potential links to accreditation; the role of public reporting; healthcare facility design; change management strategies; visible leadership and role modelling; collaboration between facilities and with public health; reducing hospital overcrowding; and accountability and funding. Finally, the impact of the burgeoning interest of the media, the threat of legal liability and the well-being of healthcare providers are discussed.

OVER THE PAST decade, national patient safety initiatives have emerged as important drivers of quality healthcare. These initiatives followed on the heels of studies demonstrating that preventable adverse events are common, harmful and costly (Baker et al. 2004; National Steering Committee on Patient Safety 2002). Given the complexity and size of the Canadian healthcare system, it is perhaps not surprising that wholesale adoption of these initiatives has taken time. Some patient safety initiatives have been more easily accepted and implemented than others; the earliest interventions tended to be discrete, clinically based and supported by evidence obtained from clinical randomized controlled trials (RCTs). For example, there is ample clinical evidence supporting the use of acetylsalicylic acid, beta blockers and thrombolytics in improving outcomes for patients suffering from an acute myocardial infarction (Safer Healthcare Now! 2007). If these interventions are not adhered to, it is clearly evident to healthcare providers, administrators and the public that optimal evidence-based care is not being provided and that potential harm may result. Although it invariably takes time to educate stakeholders as to the benefits of implementing such interventions and to secure funding for them, other

barriers should be minimal.

More recently, healthcare-associated infections (HAIs) have become a significant part of the patient safety agenda. The prevention and control of HAIs represent a significant challenge as the incidence of many of these infections is increasing in Canada and these infections cause considerable morbidity and mortality (Pittet 2005). A Canadian point prevalence study involving teaching hospitals from across the country revealed that 10.5% of hospitalized patients were suffering from an infection they acquired in hospital (Gravel et al. 2007). This percentage is similar to numbers reported from other developed countries (Kampf et al. 1997; Muhlemann et al. 2004; Scheel and Stormark 1999). When this percentage is extrapolated to the entire Canadian population, it is estimated that well over 200,000 hospitalized patients a year acquire infections while in hospital. Despite these staggering numbers, there has been a sense in the infection-control community that healthcare workers are less likely to view these infections as safety concerns in the same way that they view medication errors or fall prevention, and that initiatives to prevent and control HAIs have been slower to get off the ground (O'Boyle et al. 2001).

This paper explores and discusses some potential reasons why patient safety initiatives targeting HAIs have been slow to be adopted by healthcare administrators and providers, and suggests strategies to improve their implementation.

Background

Common HAIs include urinary tract infections in catheterized patients, surgical-site infections, ventilator-associated pneumonias and central venous line infections (Burke 2003). For each of these, infection results during a patient's hospitalization for another medical issue and, specifically, as a consequence of an intervention performed as part of treatment. Instrumentation of the urinary or respiratory tract or of veins with indwelling devices results in a breach of natural host defences and can allow for the entry of bacterial pathogens into normally sterile sites. Similarly, surgical-site infections can occur because surgical procedures breach the skin and allow bacteria to colonize and infect sterile tissues. A large body of research has shown that developing any one of these infections increases morbidity and mortality and results in a prolonged length of stay (Foster and Clark 2008; Pittet 2005).

Fortunately, it is estimated that a substantial percentage of these infections can be prevented if a series of strategies are followed before, during and after these interventions are performed. For example, in the case of surgical-site infections, avoiding shaving the operative site, administering appropriately timed prophylactic antibiotics, maintaining the patient's core body temperature and controlling blood glucose in diabetics during the procedure all decrease post-operative infection rates (Safer Healthcare Now! 2008b). Similar process interventions have been validated for central line infections and ventilator-associated pneumonia (Safer Healthcare

Now! 2008c). Both the American Institute for Healthcare Improvement and its Canadian counterpart, Safer Healthcare Now! provide many examples of institutions that have seen dramatic reductions in infection rates following the aggressive implementation of these strategies (Berenholtz et al. 2004; Pronovost et al. 2006; Safer Healthcare Now! 2008c).

In addition to the infections previously discussed, which can be caused by multiple bacterial pathogens, there has been growing concern and emphasis placed on so-called superbugs that are increasingly linked with HAIs. Further, these organisms have received much media coverage, and there is growing public awareness of their existence in Canadian hospitals (Nicolle 2007). There is ample evidence that the incidence of two such superbugs – namely, methicillin-resistant *Staphylococcus aureus* (MRSA) and *Clostridium difficile* – is increasing every year in our hospitals (Canadian Nosocomial Infection Surveillance Program 2005, 2006, 2007). Both of these species have been shown to cause considerable morbidity and mortality. In the case of MRSA, approximately 20% of patients who become colonized go on to develop an infection (Davis et al. 2004). Colonization refers to the presence of an organism on or in a patient that has not caused clinical disease. MRSA infections tend to be serious and may involve skin and soft tissues, heart valves, intravenous or implanted devices, bones and joints, lungs and many other sites (Moreillon et al. 2004). Both colonization and infection with MRSA typically prolong the length of patient stay. The attributable mortality rate for MRSA is higher than that for drug-sensitive *S. aureus* (Cosgrove et al. 2003). Finally, MRSA infections require the use of different, typically more expensive and potentially toxic antibiotics that are sometimes less effective than the traditional beta lactam antibiotics used to treat drug-sensitive infections (Moreillon et al. 2004).

It has been known for decades that MRSA is spread largely via the transiently colonized hands of healthcare workers who move from colonized or infected patients to uncolonized patients without properly cleaning their hands. Healthcare worker compliance with hand hygiene has been identified as a significant problem in modern healthcare and one that has proven quite difficult to solve (World Health Organization 2006).

In addition, many studies have shown that MRSA can extensively contaminate the environment surrounding MRSA-colonized or -infected patients (Yamamoto and Marten 2008). MRSA has been isolated from such locations as beds and bedrails, bedside furniture, doorknobs, call bells, multi-use equipment and curtains. Once present in the environment, the organism can persist for weeks if contaminated areas are not cleaned and disinfected appropriately (Yamamoto and Marten 2008). While MRSA is relatively easily killed by typical hospital disinfectants, there are myriad examples of contaminated environments having likely contributed to outbreaks. Finally, although healthcare worker colonization with MRSA is typically transient and limited to their hands, healthcare workers can become colonized in the nose and skin, resulting in prolonged carriage and posing an increased risk of transmission to patients and other healthcare workers (Sherertz et al. 2001).

C. difficile causes symptoms that range from mild to severe diarrhea, toxic megacolon leading to possible bowel perforation or sepsis, and death. Illness results from the production of toxins by the bacterium. It is estimated that approximately 4–15% of Canadian patients with *C. difficile* infection die as a result of their HAI (Canadian Nosocomial Infection Surveillance Program 2005, 2007). Furthermore, patients can suffer from recurrent or relapsing *C. difficile* infections that may require multiple courses of treatment or

that may be refractory to standard treatment (Canadian Nosocomial Infection Surveillance Program 2007; Pepin et al. 2004).

Like MRSA, *C. difficile* can extensively colonize the environment; however, *C. difficile* is even more problematic in that it can produce spores that are highly resistant to the usual disinfection methods (DuPont et al. 2008). Spore contamination of the environment may theoretically last for years. Regular cleaning procedures are important for the physical removal of some spores but will not kill spores; therefore, ineffective and improper cleaning and disinfection may ironically spread the organisms far beyond their original source. More caustic disinfectants are required to kill spores. Recently, a new sporicidal disinfectant has become available that uses accelerated hydrogen peroxide. Another alternative is a sodium hypochlorite solution (diluted household bleach), which may be more difficult to use on a broad scale because of its fumes and tendency to irritate. Regardless of which product is chosen, it is imperative that a sporicidal agent be used when cleaning the environment occupied by patients with a known *C. difficile* infection.

C. difficile is also believed to be spread by healthcare workers' hands. Spores are known to be resistant to alcohol, which has caused some to question the use of alcohol-based hand rubs and to recommend the use of soap and water to physically remove spores from the hands (Healthcare Infection Control Practices Advisory Committee 2002). While a concern, it is not at all clear that hand hygiene with alcohol based hand rub is ineffective in controlling *C. difficile* when combined with appropriate infection control practices such as the use of contact precautions.

The role of the environment in the spread of *C. difficile* has been amply described, including the risk to patients occupying a bed previously vacated by a patient infected with

C. difficile (DuPont et al. 2008). Antibiotics are also considered to play an important role in the development of a *C. difficile* infection – by killing off other normal bowel bacteria, broad-spectrum antibiotics such as third-generation cephalosporins and quinolones, and anti-anaerobic drugs such as clindamycin, allow *C. difficile* to thrive in the bowel without competition and to produce toxins (DuPont et al. 2008). To a lesser extent, cancer chemotherapeutic agents predispose to *C. difficile* infection, and proton pump inhibitors have also been postulated to play a role (Dial et al. 2004). *C. difficile* infection may occasionally develop in the absence of drug exposures.

An added worrisome complication to the spread of *C. difficile* in Canada is the emergence of a highly virulent strain referred to as NAP1 (DuPont et al. 2008), which carries a gene mutation that results in constant toxin production at a 16- to 23-fold rate over other strains (Warny et al. 2005).

From a theoretical perspective, controlling the spread of pathogens such as MRSA and *C. difficile* in Canadian healthcare facilities is quite simple: scrupulous environmental cleaning and near perfect compliance with hand hygiene practices undoubtedly limit transmission. Unfortunately, compliance with both these measures is less than ideal in practice. Environmental services may not be adequately staffed or funded in many hospitals, and housekeeping staff may not recognize the crucial importance of their role in patient safety. Hand hygiene compliance by healthcare workers has been demonstrated to be consistently poor: a number of surveys have shown that, without specific intervention, healthcare workers clean their hands on average less than half as often as they should (Haas and Larson 2008; Pittet et al. 2000). Modifying healthcare worker behaviour to improve hand hygiene compliance is a universal challenge within healthcare facili-

ties around the world (Grol et al. 2007; Pittet 2005; Weinstein and Stroger 2004). Despite the fact that cleaning one's hands is a relatively simple procedure, made increasingly so due to the availability of alcohol-based hand rubs, healthcare workers' behaviour surrounding hand hygiene is surprisingly complex and remains difficult to understand, explain or change (O'Boyle et al. 2001).

In summary, HAIs are serious, preventable adverse events, similar to other patient safety issues. In general, we know how to prevent and control them and there have been some dramatic success stories. So, why are there difficulties in universal implementation of strategies to control HAI?

What Makes HAIs Seemingly Different?

Consider the following case scenarios:

Four patients are admitted to an intensive care unit (ICU). During the course of their stay, all four suffer adverse, unplanned events. The first patient receives double the recommended dose of the antibiotic amikacin for four days, resulting in renal failure requiring dialysis. The second substantially recovers from her initial illness only to fall out of bed and fracture her hip. The third develops a blood stream infection with *Candida albicans* secondary to an infected central venous catheter that was inserted on the day of admission. The fourth patient acquires MRSA one week after admission and subsequently develops MRSA pneumonia, requiring him to receive mechanical ventilation.

Each of these events has a similar negative impact on the patient; yet, each is likely to be treated differently. The occurrence of any healthcare-associated adverse event typically results from a combination of patient, health-

care worker and systemic factors. Depending upon the adverse event, some factors are more prominent than others. These four adverse events are similar in several ways: their occurrence almost assuredly prolongs the length of stay, they cause serious harm to the patient and all are theoretically preventable.

Medication errors have long been recognized as important and common patient safety issues. It is highly likely that the amikacin overdose would be disclosed to the patient and family. The event would probably be brought to the hospital quality-of-care committee or to morbidity and mortality rounds. The hospital would be concerned about possible liability. The treating team would perform a root-cause analysis to determine the origins of the error; for example, was an incorrect dose ordered by the physician, was the error not identified and flagged by the pharmacy or was a transcription error made? The root-cause analysis would undoubtedly identify the origin of the error, and steps would be taken to ensure that such an event would not be repeated.

Likewise, the fall event would typically be seen as something that could have been prevented, especially for a patient in intensive care where nursing-to-patient ratios are often one to one. Again, root-cause analysis may reveal both healthcare worker causes, such as leaving the bed rails down after changing a dressing, and systemic causes, such as staff who are overworked and are unable to check on patients as frequently as required. Falls may also involve patient factors, such as dementia, disability or severity of underlying illness.

The two final adverse events, namely the central line infection and MRSA pneumonia, would more likely be treated as “costs of doing business.” In other words, when patients are admitted to an ICU, their serious underlying illness and the interventions necessary to treat them are viewed as inevitably predisposing to infection. While the patient and family might

be informed of the infection, in all likelihood it would not be presented as a preventable event but, rather, as a complication of care. The adverse events would normally not be discussed further or brought to a higher level of scrutiny; they may be recorded as a “statistic” by the infection prevention and control department.

We propose that these differences in approach to adverse events such as medication errors, falls and HAIs ultimately stem from a number of factors: a longstanding and widespread belief that antibiotics can solve problems related to infection – so prevention is unnecessary; the “lack of strength” of the evidence supporting interventions to prevent HAIs; the degree of ownership that healthcare workers feel for the problem and the perceived level of intractability of the problem.

Antibiotics to the Rescue

Since the discovery of penicillin in the 1940s, there have been various ultimately naive pronouncements regarding how infectious diseases would soon be eliminated. Unfortunately, the speed at which bacterial pathogens multiply and mutate has ensured that resistant populations are selected for soon after a new antibiotic comes on the market. Indeed, penicillin-resistant *S. aureus* was identified within a few years of the commercialization of penicillin and became widespread throughout the world within a matter of a few decades (Gardam 2000). The trend for most hospital pathogens is to become increasingly resistant each year, and for other previously less worrisome pathogens such as fungi and *C. difficile* to emerge as significant concerns, all secondary to constant antibiotic-selective pressure (Struelens 2003).

It is a general medical truism that prevention is superior to treatment – both in terms of patient outcome and costs – and this is no different for infectious diseases. The costs of diagnosis, therapy and hospitalization, where

necessary, all far outstrip the more modest investments required to prevent undesirable outcomes in the first place. Yet initiatives to prevent disease usually fall short of those focused on medical intervention, likely because it is easier to order an antibiotic than it is to change behaviours or consider non-pharmaceutical alternatives. Also, it has been our experience that core medical training tends to focus on reacting to diseases rather than preventing them. To this day, discussion around HAIs on the infectious diseases consult service rarely, if ever, turns to how such infections could be prevented; rather, it focuses on antibiotic options and follow-up for complications. Finally, in a situation such as bacterial septic shock secondary to an infected central venous line, antibiotics often have limited impact on the patient outcome.

Another important consideration is the current paucity of new antibiotics in the pharmaceutical pipeline. In general, antibiotics are not nearly as profitable for pharmaceutical manufacturers as are medications for chronic diseases that are taken by patients for years to decades. Furthermore, the tendency of bacteria to develop resistance to newer antibiotics renders these agents obsolete early in their marketing lifetime, making them even less attractive as a profit generator. It is a well-known fact that the “golden era” of antibiotics is over, and it is becoming commonplace to encounter healthcare-associated organisms for which there are few or no good antibiotic therapy options.

Where Is the Evidence That Infection Control Works?

Most infection-control research has tended to be observational in nature and has typically described the control of infections following the implementation of multiple concurrent interventions. For example, enhanced hand hygiene, patient isolation and cohorting, the

use of additional barriers such as gowns and gloves when in contact with patients, patient screening and limiting new patient admissions may be used concurrently to control a significant MRSA outbreak. Since we are aware of routes of transmission for organisms causing HAIs, as well as the fact that there is often poor healthcare worker compliance with routine practices such as hand hygiene, the use of multiple interventions is an appropriate approach. Indeed, it would neither be ethical nor desirable to randomize patients to a single control measure when they are being exposed to a dangerous pathogen; the most important consideration is to stop the outbreak as quickly as possible to minimize morbidity and mortality. Similarly, one cannot ethically randomize patients to receive care from staff who always wash their hands or from those who are ordered not to do so, or to a room that is cleaned regularly and properly versus one that is left dirty after the previous patient.

Hence, infection-control interventions do not have the level of evidence supporting their implementation that many other patient safety strategies have. As an example, interventions to improve patient outcomes post-myocardial infarction are supported by large RCTs, considered the highest level of evidence. It has been our experience that physicians trained in evidence-based medicine frequently challenge infection-control and public health measures because of the lack of RCT evidence, and argue that the evidence is not robust enough for them to follow the interventions. Thus, while hand hygiene and aseptic technique have been shown, often very dramatically, to have a strong association with improved outcomes since the 19th century, the importance of these associations continues to be questioned to this day (Weinstein and Stroger 2004). This leads to the rather odd situation of highly educated healthcare workers questioning the validity of a rigour-

ous hand hygiene protocol because of a lack of “hard” evidence in stark contrast to its acceptance by patients who feel that the need for hand hygiene is patently obvious.

This Is Not My Problem

Medication errors are relatively black-and-white events: the patient receives a drug or dose different from what he or she was supposed to receive, and the healthcare team is able to easily recognize this as an error. It is typically straightforward to identify where the error originated and, while patient safety culture does not attribute blame, to identify which staff member(s) caused or perpetuated the error. There may also be a systemic issue that on identification can be addressed, such as the lack of a computer flagging system that would automatically identify inappropriate medication doses.

HAIs, on the other hand, are typically attributable to systemic and multifactorial causes in addition to patient factors predisposing them to infection. Despite the fact that it is known that bacteria such as MRSA are spread throughout facilities via healthcare workers’ hands and environmental contamination, it is impossible to prove that it was any one individual’s dirty hands or incomplete environmental cleaning that resulted in a particular patient’s infection. Indeed, a patient who acquires MRSA during a hospital stay typically has been in contact with multiple pieces of equipment as well as hundreds of hands, any one of which might have delivered the organism. The lack of ability to attribute HAIs to one or two individuals or to a faulty piece of equipment means that the typical root-cause analysis used for other adverse events is not necessarily helpful and may in fact be frustrating as one rapidly reaches the conclusion that everybody is potentially at fault. Indeed, a root-cause analysis would need to consider issues such as overall healthcare worker

compliance with hand hygiene, cleaning protocols of rooms and equipment, compliance with contact precautions and other such issues. Interventions to prevent future adverse events from happening therefore require systematic culture change, a difficult undertaking known to be prone to failure (Grol et al. 2007).

There Is Nothing We Can Do about the Problem Anyway

As previously noted, infection-control workers are often challenged by their clinical colleagues regarding the usefulness of control measures. While this partially relates to the lack of hard evidence in support of infection-control practices, it also relates to the intractability of some infection-control issues. Adverse events such as central line infections may be amenable to practice improvements, such as training staff who perform line insertions to use specific skin antiseptics and proper sterile technique; however, the improvement of infection-control practices has proven difficult. Indeed, it has been our experience that front-line staff frequently express fatigue with a seemingly endless number of patient situations that require the implementation of some sort of infection-control precaution such as the use of single rooms and gowns and gloves. And it is not unusual to hear comments questioning infection control since “nothing seems to work.”

One of the most intractable challenges has been improving healthcare worker compliance with hand hygiene practices. Numerous studies have explored barriers to following hand hygiene guidelines as perceived by healthcare workers. A 2001 study found that being “too busy” was a common reason given by healthcare providers for not performing hand hygiene, in spite of the widespread recognition of the prevention of patient infections as the most important impetus to perform hand hygiene (O’Boyle et al. 2001). Additional

perceived barriers are a lack of sinks in the immediate environment, a sense that the need to provide patient care is more pressing than hand hygiene, complaints that hand hygiene products cause irritated and dry skin and an inadequate knowledge of hand hygiene guidelines (Lankford et al. 2003). Further, healthcare provider adherence to guidelines can be affected by disagreement with or skepticism regarding the guidelines; the belief that the use of gloves negates the need for performing hand hygiene; the feeling that frequent hand hygiene may interfere with patient relations; forgetfulness; a lack of peer or supervisor role models; and an absence of hand hygiene as an institutional priority (Pittet 2002).

Notably, healthcare providers can be both influenced by and influential on their social environments, and behaviour in this context is often influenced by social pressures (Pittet 2005). Specifically, role models, group behaviour and the level of managerial support in a given institution have an influence on reported levels of hand hygiene compliance within healthcare settings (Lankford et al. 2003). A 2003 study found that healthcare workers present in a room with a senior staff member who did not wash his or her hands were significantly less likely to wash their own hands (Lankford et al. 2003). Further, interventions to improve hand hygiene compliance must be multi-faceted in nature. A review of 22 studies assessing interventions to improve hand hygiene found that educational interventions had only a short-term effect; the use of reminders such as posters and signs had a small but sustained effect; the implementation of a new soap or alcohol-based hand rub had a small or unclear effect; and multi-faceted campaigns that included education, written materials, feedback and reminders had a pronounced and sustained effect on hand hygiene practices as well as on rates of HAIs (Grol and Grimshaw 2003).

One well-known intervention that has successfully achieved sustained improvement in hand hygiene compliance and an associated decrease in HAIs is the campaign at the University of Geneva Hospitals in Switzerland (Pittet 2005). This campaign, called Hopisafe, undertakes a multi-faceted approach including key activities such as repeated monitoring of hand hygiene compliance with feedback; the use of communication and education tools; the use of visual cues in the work environment; active participation of and feedback from staff both at the individual and organizational levels; and getting support from senior management and institutional leaders (Pittet 2005). Rolled out in 2007, the Ontario Just Clean Your Hands initiative also uses multiple strategies, and it is hoped that a positive result similar to that of the Geneva experience will ensue (Ontario Ministry of Health and Long-Term Care 2008a).

It is important to note that, while there has been a steady increase in Canadian rates of MRSA and *C. difficile* over the past decade, it is unknown what these rates would have been had no control measures been implemented. We do know that overall US rates are typically many-fold higher than Canadian rates and that many US hospitals have not historically followed similarly stringent control measures.

There have also been incredible successes in Europe and Scandinavia. In the 1970s, MRSA accounted for 30% of hospital-associated *S. aureus* infections in Denmark, Finland and the Netherlands; today, the prevalence of hospital-associated MRSA infections in those countries is less than 1% (Muto et al. 2003). This remarkable turnaround was accomplished using very aggressive and expensive control measures including presumptive isolation of patients until they were proven to be MRSA negative on screening cultures, repeated screening of staff for MRSA, repeated attempts at decolonization of MRSA-positive patients and staff and

high levels of environmental cleaning. While clearly successful, these interventions still focus on managing the end point problem rather than on primary prevention. One of the further challenges of such a focused active surveillance and control strategy is that while MRSA rates may be reduced, other new pathogens may not be detected or controlled. To enable the control of many pathogens simultaneously, including ones that have not yet been identified, broad-based strategies targeting personal and group behaviours must be applied.

Moving Forward

Fortunately, an era of embracing patient safety has arrived, and increasing attention and energy have been focused on the prevention of medical errors. We have seen huge strides on issues that only 10 years ago received little attention from the healthcare system and public. A case in point is medication reconciliation, a process that ensures that patients receive the correct medication(s) when admitted from home to hospital and again when discharged. Successful implementation of medication reconciliation requires a multi-disciplinary approach and is labour intensive (Safer Healthcare Now! 2008a). One of the main driving forces behind its success has been its adoption by Accreditation Canada as a required organizational practice (ROP).

However, solutions to a multifactorial and systemic problem such as HAI must themselves be multi-faceted in nature. Below we outline a series of possible solutions as well as activities that may influence the problem, but it must be kept in mind that no one of these will be a solution unto itself. Furthermore, if not appropriately applied or focused, some of these measures may have little impact on the overall HAI problem in our hospitals.

Links to Accreditation

In 2008, compliance with patient safety ROPs

was made a requirement of Accreditation Canada surveys. Included among these are ROPs related to infection control, such as compliance with hand hygiene, adherence to protocols and tracking and reporting of HAIs (Canadian Council on Health Services Accreditation 2007). We anticipate that this linkage with accreditation standards will help to ensure that HAIs receive greater priority status on the patient safety agenda by bringing them to the attention of senior administrators. It is crucial, however, that ROPs be focused on the most important infection control measures, such as those that if successful will have a large impact on patient safety and also impact upon a large majority of patients e.g., hand hygiene. Focusing on highly labour intensive measures such as post-discharge surveillance for surgical site infections will evidently not help non-surgical patients and will furthermore pull resources from other strategies.

Public Reporting

Another recent development in several jurisdictions is the implementation of mandatory public reporting of rates of key HAIs. Like accreditation ROPs, public reporting draws attention to an issue and increases the likelihood that pressure will be placed on administrators to address it. It also allows patients, administrators and funders to compare rates between comparable institutions; for patients, this may allow for choice of where care is sought; and for administrators and funders, it may allow for targeted accountability measures. Further, public reporting identifies facilities that may benefit from external review and expertise.

In Ontario, rates of healthcare-associated *C. difficile* infection acquired in each Ontario hospital are now posted on a public website (Ontario Ministry of Health and Long-Term Care 2009). Similarly, rates of MRSA blood-stream infection acquired in each Ontario

hospital and of bloodstream infection secondary to another superbug, vancomycin-resistant enterococci (VRE), are publicly available. Beginning in April 2009, rates of central line infection, ventilator-associated pneumonia and surgical-site infection, and of hand hygiene compliance, will be posted publicly on a hospital-by-hospital basis.

One risk of public reporting is that it may be an incentive to “count” rather than *change* cultures and behaviours: as public reporting requirements increase, infection-control staff will find it increasingly hard to find time to work with front-line healthcare workers – the very individuals they need to influence. It is also important that the meaning of indicators be communicated to the public: for example, MRSA and VRE bloodstream infections, while useful quality indicators, hardly represent the total burden of disease caused by these organisms. An uninformed public may wrongly conclude that these organisms are not a significant concern.

Healthcare Design

Healthcare design has been shown to impact upon multiple factors relating to patient safety, including the risk of falls, provision of adequate pain management and the risk of HAIs (Joseph and Rashid 2007). It is relatively easy to envision how multi-bedded rooms facilitate the spread of MRSA and *C. difficile* between patients through environmental contamination. Multi-bedded rooms may also negatively impact hand hygiene compliance as healthcare workers can move between patients without encountering a hand hygiene sink or an alcohol-based hand rub (Joseph 2006). Further, the typical layout and clutter of four-bedded rooms makes it quite difficult to place alcohol near the point of care. Other factors that may negatively impact upon hand hygiene compliance include empty alcohol dispensers and dispensers that are not highly visible.

Unfortunately, the average Ontario hospital is over 40 years old and was built at a time when four-bedded rooms with shared washrooms and open concept ICUs were the norm. Hand hygiene sinks in older facilities are frequently non-existent, and healthcare workers are forced to use patient washroom sinks. It is also frequently difficult to isolate patients with MRSA or *C. difficile* in single rooms as per infection-control protocols due to a lack of these rooms. Older hospitals also tend to have a critical lack of storage space, having been built in an era when computers, patient lifts, intravenous pumps and other pieces of complex equipment were not available, leading to crowded hallways and patient rooms that are hard, if not impossible, to clean appropriately. Finally, older facilities rarely have appropriate infrastructure to safely manage human waste for a patient population that is increasingly bed-ridden and far more medically complicated than 40 years ago.

There is no doubt that hospitals being built today must include a large majority, if not all, of their beds as single rooms. Indeed, there are so many advantages to single rooms over and above those related to the prevention of infections that anything less than 100% single rooms is hard to justify (Joseph 2006; Ulrich et al. 2004). New buildings must provide adequate and accessible storage space for patient care equipment as well as for personal protective equipment such as gowns, gloves and masks; this will greatly increase the likelihood that personal protective equipment is used. Finally, appropriate human waste elimination systems that minimize the spread of fecal organisms, such as private washrooms, bedpan washers/disinfectors or macerators, must be used.

Change Management Strategies

Change management strategies may play a significant role in improving rates of HAIs.

Preliminary data from six American hospital sites suggest that dramatic improvements in MRSA rates can result from engaging front-line healthcare workers to take ownership of the issue using positive deviance change methodology. *Positive deviance* is based on the premise that solutions to problems already exist within an organization or community. It does not focus on telling others what they need to or should be doing; rather, it draws ideas for change from the workers. As such, there is less focus on education or on the traditional role of infection control as the keeper of all things related to HAIs, and front-line providers take ownership over and implement their own ideas and solutions.

Using positive deviance methodology, the surgical ICU at Albert Einstein Medical Center, Philadelphia, Pennsylvania, was able to report a 70% drop in the rate of healthcare-associated MRSA infections between 2006 and 2008. Similarly, the ICUs at the Billings Clinic in Billings, Montana, and Franklin Square Hospital Center, in Baltimore, Maryland, experienced a 100% drop in the rate of healthcare-associated MRSA infections over the same time period (Plexus Institute 2009).

Visible and Engaged Senior Leadership

Role modelling is important, particularly for key behaviours such as hand hygiene and compliance with precautions to prevent the transmission of HAIs. Physicians have consistently been shown to have very poor compliance with hand hygiene measures in comparison with other healthcare workers, and their behaviour tends to undermine strategies to improve compliance. Ensuring that change management strategies include staff physicians is an important element. Also, the role of administrative leadership – from the chief executive officer, executive team and board – should not be underestimated; since

the multifactorial interventions required reach beyond clinical services, leadership from the top is necessary for coordination across the complex organization of a modern hospital.

Collaboration

HAIs are a systemic problem, with similar underlying causes across different facilities. As such, facilities may often learn from one another based upon similar experiences and challenges. What may seem like a daunting problem for one facility may have a pragmatic solution that was developed at another facility.

Increasingly, communities of practice are becoming important tools in the sharing of knowledge and experience (Safer Healthcare Now! 2006). Safer Healthcare Now! has employed collaboratives for their interventions, often with great success. Similarly, sharing experiences is a key component of positive deviance; however, this sharing is not about best infection-control practices but, rather, the process of engaging front-line staff.

In addition to collaboration between facilities, there needs to be collaboration between hospitals and the community. Infectious disease control in communities has traditionally been the responsibility of public health, while hospitals have tended to focus internally on infection control within their own walls. The spread of MRSA in healthcare facilities and communities is a good example of the need for collaboration: once only a healthcare pathogen, healthcare strains have moved into the community as patients have been discharged. At the same time, community strains have arisen independently and are now spreading in hospitals. Focusing on MRSA control in both settings is needed to achieve control.

Improvement in Hospital Overcrowding

A long-term strategy to lowering rates of HAIs involves reducing the proportion of hospitalized patients who do not actu-

ally require hospital care. It is common for Ontario hospitals to be near 100% capacity. Indeed, in some communities where there is only one hospital, occupancy rates can climb above 100%, with patients occupying lounges and hallways. It is obvious that in such settings patients are at risk for many types of adverse events, including HAIs, as overworked staff try to care for patients in an environment that makes it difficult for them to follow best practices.

Almost 20% of in-patients could be cared for in a non-hospital setting (Ontario Ministry of Health and Long-Term Care 2008b), yet there are often no beds available for them in complex continuing care and rehabilitation facilities, and nursing homes. To compound the problem, elderly patients with complex medical problems are highly prone to HAIs. A strategy to create spaces for these patients in non-hospital settings would reduce both overcrowding and the rate of HAIs.

Accountability to Funders and Enforcement

The current funding structure for Ontario hospitals includes accountability agreements. With the implementation of mandatory reporting of rates of HAIs, the opportunity exists to consider including accountability indicators in these agreements that focus on the *prevention* of HAIs for facilities that have unacceptable rates of HAIs because of a failure to use validated patient safety strategies. We suggest that such indicators should only be considered and used in making funding decisions if, upon external review, a facility continues to have unacceptable rates of healthcare associated infections because of failure to use validated strategies. Enforcement strategies whereby institutions or individuals are audited and reprimanded if they do not meet targets may also be considered as part of a larger multi-faceted strategy. One recent example of successful enforcement was reported at Cedars

Sinai Medical Center where non-compliant healthcare workers were reprimanded, culminating in a recalcitrant physician losing his hospital privileges. (Roehr 2007).

However, it is clear from other change initiatives that enforcement alone is unlikely to bring about lasting culture change and may in fact result in resistance. Furthermore, central to any accountability or enforcement strategy is the need to provide educational materials and supports and to have clear, attainable targets that facilities and individuals are expected to reach. Finally, it is important to differentiate between best practices and minimum standards: targets should correspond with minimum standards.

A Different Role for Infection Control Departments

Knowledge of and adherence to a facility's infection control policies and clinical best practices are foundations for the prevention and control of healthcare associated infections. One stumbling point for infection control departments in the past has been a tendency to own and feel responsible for all infection control issues, rather than focusing on strategies that foster ownership of these issues by front line providers. Infection control staff are the content experts and must remain visible and available to provide advice and direction; however a bigger picture approach can be taken across facilities, with greater ownership and collaboration between all healthcare providers, including infection control.

Cooperation and Collaboration with Public Health

Infectious disease control in communities has traditionally been the responsibility of public health, while hospitals have tended to focus internally on infection control within their own walls. As communicable diseases like MRSA and *C. difficile* move between facilities

and in between the community and facilities, the need for role clarity between public health practitioners and hospital infection control specialists is of vital importance. Approaches to management, and even definitions of cases and outbreaks, can be different between these two solitudes.

Other Considerations

While not part of specific strategies to reduce HAIs, the growing media and public interest, threat of litigation, concern for one's well-being as a healthcare provider do certainly have an impact on the incidence of HAIs.

Burgeoning Media Interest

Like public reporting of rates of healthcare associated infections, accurate media reporting regarding the impact of these infections draws necessary attention to the problem. Timely and relevant reporting on issues as they emerge galvanizes interest and action, not only by healthcare workers but also by the public. For example, in 2007, the Canadian Broadcasting Corporation program *Marketplace* reported on HAIs by going undercover in two Canadian hospitals to film healthcare worker practices (Canadian Broadcasting Corporation 2007). Anecdotally, this had a considerable impact on both hospitals and the public. Empowering the public to ask healthcare workers about HAIs and compliance with control strategies such as hand hygiene could have a powerful impact upon culture; however, it is important that patients not feel pressured into challenging their healthcare workers' practice as this may be extremely uncomfortable for the patient.

Litigation May Be Looming

The harm resulting from HAIs is theoretically preventable, so it is no surprise that lawsuits have begun to surface. Indeed, class action suits have been launched in relation to

C. difficile and MRSA outbreaks in several Canadian provinces. It behooves healthcare administrators and insurers to become increasingly aware and engaged in active prevention strategies to mitigate the risk of possible liability resulting from uncontrolled outbreaks or unacceptable high rates of HAIs.

Occupational Health and Safety

While we have focused on this issue from a patient safety perspective, we must also bear in mind that the healthcare worker is also at risk of acquiring infections; as such, the control of these pathogens is an important occupational health and safety issue. Moving forward, it will be important for infection-control practitioners and occupational health and safety specialists to work together, recognizing that both bring valuable insight and perspectives.

Conclusion

There are three great barriers to be overcome in improving patient safety when it comes to HAIs: recognizing that they are a real, preventable patient safety concern; realizing that there is no quick fix for the situation; and acknowledging that improvement is possible if the problem is approached in the right manner. The media is replete with stories of the public being shocked that things as simple as hand hygiene and environmental cleaning are not being adequately performed. This is understandable, yet we must move beyond being shocked if we hope to make a difference. HAIs are a significant problem facing modern healthcare, with complex causes and solutions that require dedication and focus. But there are solutions, and the problem can be overcome if we embrace and engage available strategies.

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