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Mobilising for safer care: addressing structural barriers to reducing healthcare-associated infections in Vancouver, Canada

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Programs and reforms to prevent healthcare-associated infections encounter structural barriers that affect their adoption and effective implementation. This article is based on interviews with 55 frontline healthcare providers, infection control and quality experts, and policymakers from 2010–2013 primarily in Vancouver, Canada. This article reports the perceptions of participants regarding the consequences that structural barriers, including physical structure, staffing levels, education, policy variations, and authority, have on their ability to prevent healthcare-associated infections. The findings suggest the need to shift more funding to preventative measures, such as more infection-prevention professionals, higher participation in quality programs and increased availability of isolation rooms to reduce healthcare-associated infections. In addition, leadership and resources are needed to expand (1) mandatory annual infection prevention education sessions to all hospital staff with point of care follow up, and (2) standardised, evidence-based antimicrobial stewardship clinical practice guidelines and policies.

Keywords: Canada; healthcare-associated infections; patient safety; structural barriers; infection control; antimicrobial stewardship

Introduction

Healthcare-associated infections (HCAIs) remain a leading cause of morbidity and mortality in Canada and internationally (McCarter, 2008; Pittet & Donaldson, 2005; Van Iersel, 2007). Approximately one in ten hospitalised patients are estimated to acquire an HCAI in Canada, contributing to approximately 220,000 annual infections and between 8,000 to 12,000 annual deaths (Zoutman et al., 2003). The treatment of HCAIs alone is estimated to cost the Canadian healthcare system approximately $1 billion (CAD) per year (Van Iersal, 2007). At the same time, research evidence supports the effectiveness of infection control programs and policies for reducing the incidence of HCAIs, and 30% to 50% of HCAIs are preventable (Canadian Committee on Antibiotic Resistance, 2007; McCarter, 2008; Peleg & Hooper, 2010; Zoutman et al., 2003). For

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specific HCAIs, such as catheter-related and central line-associated blood stream infections, studies have demonstrated that more than 60% are avoidable (Centers of Disease Control and Prevention, 2005; Pronovost et al., 2006). Despite evidence that directed programs, policies and reforms reduce HCAIs, structural and other barriers compromise their adoption and effective implementation.

Background

HCAIs result from bacterial, viral or fungal infections, which patients acquire while receiving treatment for other conditions during hospitalisation (McCarter, 2008). Of great concern in this context are bacteria that are resistant to multiple antibiotics (Grgurich, Hudcova, Lei, Sarwar & Craven, 2012, Morgan, Lomotan, Agnes, McGrail & Roghmann, 2010). HCAIs that are associated with high morbidity include infections that affect the respiratory tract, bloodstream, gastrointestinal and intra-abdominal system, surgical site wounds, skin and soft tissues, or multiple body sites (Fabbro-Peray et al., 2007). Examples of causative pathogens include methicillin-resistant *Staphylococcus aureus* (MRSA), *Clostridium difficile*, vancomycin-resistant *Enterococcus* (VRE), multidrug-resistant *Acinetobacter baumanii,* noroviruses, and respiratory viruses.

Numerous evidence-based infection control programs are in place across Canada to prevent the acquisition of HCAIs. Some examples of these initiatives include efforts to improve healthcare worker hand hygiene (Hillburn et al., 2003; Pashman et al., 2007; Pittet, 2000), implementation of checklists (Haynes et al., 2009; Pronovost et al., 2006), and application of barrier precautions (Gravel et al., 2009a; Ofner-Agostini et al., 2007). These programs have all been implemented to some degree in Vancouver-area hospitals (www.picnet.ca), yet have achieved varying success in terms of compliance and execution. Gamage, Varia, Litt, Pugh, and Bryce (2008), for example, report that there is uneven monitoring of HCAIs in British Columbia acute care facilities, including the use of inconsistent surveillance methodologies. Programs in British Columbia include monitoring and public reporting of selected HCAI rates, incentives to improve hand-cleaning by healthcare workers, procedural checklists for ventilator use and catheter insertion, cleaning audits, reducing misuse of antimicrobials, and improved hospital design and re-configuration. Overall, these evidence-based reforms are generally in line with a positive deviance approach to behavioural modification by healthcare workers (Gardam, 2008; Marra et al., 2010). Other kinds of improvements aim to create a safety culture through networks and organisational change, recognising the need to create an accountability culture in hospitals (Jarvis, 2007; Yokoe et al., 2008). Despite these efforts, burnout, systemic non-compliance and other challenges in creating and maintaining longer-term infection control practices remain.

Creating sustained change in healthcare worker practices has been found to benefit from a multidimensional framework (Bouadama et al., 2010). For example, qualitative studies with healthcare workers have found that networks, peer-effects, organisational culture, and personal beliefs have been shown to hinder compliance with hand-hygiene initiatives (Erasmus et al., 2009; Lankford et al., 2003). Other research suggests that nurses' beliefs in their ability to succeed in a given situation and attitude toward time-related barriers also strongly affect hand-hygiene compliance (De Wandel, Maes, Labeau, Vereecken & Blot, 2010). This research suggests that a combination of factors – operating at the macro-, meso- and micro-levels – are important for improving infection control and patient safety practices.

While previous studies have identified important programs and policies that reduce HCAIs, there has been limited research published on structural barriers that inhibit the implementation of policies and practices to reduce HCAIs in acute care settings. Structural issues might include organisational factors, governance, skills acquisition, resource mobilisation, guideline development, teamwork, experience, knowledge transfer, inequality and complex hierarchical

institutional arrangements that define the hospital environment. Other important barriers could include the consequences of the climate of fiscal austerity, retrenchment, budget cuts, staffing changes, employee frustration, work-related stress, and overlooking the potential contribution of marginalised workers. Currently, programs and policies fail to address and overcome certain structural barriers to improving infection control in hospitals. For example, overcrowding and understaffing have been demonstrated to undermine the effectiveness of hand-cleaning to prevent infection transmission (Beggs et al., 2006). Working conditions and practices for healthcare workers can directly impact patient safety; for example, hospital cleaners report the necessity to cut corners and skip steps as a result of understaffing and a lack of adequate training (Zuberi, 2013). Non-compliant healthcare workers may be acting as 'superspreaders' of pathogens throughout hospital wards (Temime et al., 2009). The objective of this study is to identify structural barriers to the successful implementation of policies and programs in order to reduce HCAIs in Vancouver regional hospitals.

Methods

Fieldwork included 55 digitally recorded semi-structured interviews from 2010 to 2013 with four categories of participants: frontline healthcare providers (18), infection control experts (18), quality improvement and patient safety experts (8), and policymakers (11). The frontline healthcare providers interviewed included physicians and nurses. The goal was to interview enough respondents in each category in order to gain saturation in terms of responses, while also accessing a diversity of perspectives (House, 2005).

Pools of potential respondents in each category were identified via their job titles or committee memberships, which indicated relevant knowledge of HCAI related issues in acute care settings. The potential respondents received invitations to participate and those who responded with expressions of interest were recruited into the study.

Interview guide

The semi-structured interview guide was developed and tested during the summer of 2010, and included both multiple-choice questions as well as questions requiring more extensive, open-ended responses. A second interviewer reviewed the transcripts of the test interviews, which were conducted with infection-control expert participants. The interviewer then modified the interview tool to highlight questions that would probe deeper into structural factors and removed several redundant queries. The use of a semi-structured interview protocol has been demonstrated to be a powerful research tool, particularly for understanding a respondent's social world, including their networks, events and processes (Denzin & Lincoln, 2005; Holstein & Gubrium, 2003; Rubin & Rubin, 2005). In-person qualitative interviewing allows for the probing of responses for more detailed information, and generates richer data than phone interviews or other kinds of survey questionnaires (Berg, 2007; McCracken, 1998; Shuy, 2003).

Ethical issues: protecting respondent confidentiality and avoiding coercion

The study procedures and protocol were approved by the UBC Behavioural and Ethics Review Board (BREB) as well as the research ethics boards of the Vancouver Coastal Health, Providence Health Care, Fraser Health Authority, and the Provincial Health Services Authority in the Vancouver region.

Active attention was paid to protect respondent confidentiality and to avoid any coercion in terms of respondent recruitment and participation. Each participant signed a consent form at

the beginning of the interview. Several measures were in place to protect participant confidentiality including storing interview transcripts without identifying information, and using pseudonyms in place of participant names in the presentation of findings. Confidentiality was considered particularly important in this study to allow participants to speak openly about barriers and to ensure that there would be no negative repercussions of participation.

Data analysis

The interviews were transcribed on an ongoing basis and analysed by the second author with the assistance of *Atlas.ti* computer software. Data analysis commenced with open coding of the data, both to address research questions in line with the original study objectives and to examine unexpected results, including common themes that emerged in the interviews (Berg, 2007). The second stage of focused coding developed subtopics, identified links and distinguished variations (Emerson, Fretz & Shaw, 1995).

Results

HCAIs: a serious challenge

Study participants were unanimous in considering HCAIs a serious challenge to individual patients and the healthcare system. Many predicted that demographic and other trends, such as globalisation and increasing antimicrobial resistance, would increase the prevalence and challenges associated with HCAIs. For example, Canada has an aging population, which means that more patients are likely to have comorbidities that may increase their likelihood of premature mortality, if they become infected. Beverly, a nurse, stated:

> A lot of our patient populations are sicker and they are elderly, elderly, elderly … As the patient population ages and then the acuity intensifies, people are going to be much more susceptible to succumbing to those infections.

Patients, such as transplant recipients or oncology patients receiving chemotherapy, whose medications suppress their immune responses to microbes, were also viewed as prone to poorer outcomes from HCAIs. Darcy, a physician, described ongoing morbidity from HCAIs for some transplant patients. He said:

> We see patients, who have particularly GI [gastro-intestinal] problems post-transplant, where they have leaks, where they just have months of recurring bad infections that we really can't cure well with anti-infectives and that continue to leak.

Invasive procedures from intravenous line insertions to prosthetic implants were reported to expose patients to the risk of acquiring an HCAI. Vincent, a physician, described how central line insertions can result in HCAIs, which spread throughout the body. He commented:

> Patients, who go into hospitals … come out with an ARO [antibiotic- resistant organism] … We know that as soon as these people get a central line, they are … more at risk for septicaemia, and we see discitis and osteomyelitis and all kinds of spread of these organisms without any ability to truly get a hold on it.

HCAIs result in thousands of deaths annually as well as substantial morbidity, which may result in chronic sequelae.

The systemic costs of HCAIs

Participants described the tremendous costs of treating (largely preventable) HCAIs. Direct costs of HCAIs included diagnostic tests, expensive anti-infectives, repeat surgeries, personnel time, extended hospital stays, and additional care after discharge. Treatment in critical care units cost thousands of dollars per day. Brad, a physician, calculated that for each case of 'ventilator-associated pneumonia, [it is] an additional four days in the intensive care unit … [at] $2,000-$3,000 per day … That is at least $10,000 right there'. Based on Brad's research on attributable morbidity and mortality from *Clostridium difficile*-associated diarrhoea, he estimated 'an associated increased length of [patient] stay due to that infection … [of] about 10 days'.

For newborns, Gloria, a hospital manager, indicated that,

> in NICU [neonatal intensive care unit], if you have an infection, … it extends their stay for a very long time because when they get sick, they go down and it just sets them back weeks and they are $1500 a day beds in there.

Beyond treatment costs, Stan, a physician, noted that there are 'easily recoverable dollars in the absence of healthcare-acquired infection and we could actually address issues of waiting lists, if you chose to put the dollars to capacity by dealing with this problem'.

Most participants (94%) indicated that HCAIs had a significant impact on a hospital's ability to operate and deliver care. Simply put, patients with HCAIs become 'bed blockers', decreasing the number of available beds, lengthening wait times and creating patient-flow challenges.

Many participants said hospitals lack an adequate number of isolation rooms, which exacerbated the challenge posed by patients with an HCAI. The shortage of private rooms to isolate infected patients caused problems with patient flow, increased workload, and elevated the risks of infection cross transmission between patients. Amy, an infection-control practitioner, explained that 'it is difficult to prevent infection, when you have four people in the same room [with] one washroom, one sink … Hospitals, which have private rooms, have [been] shown to reduce infections'.

As a result of the shortage of private rooms, non-infected patients were reportedly sometimes placed in close proximity to infected patients or patients with different types of infections were cohorted together. As Nick, an infection-control practitioner, said:

> There are not enough private rooms in the hospital to isolate people appropriately. We have issues with mixed cohorting with patients – patients with different AROs [antibiotic-resistant organisms] being in the same room together; clean patients – not being able to move them out.

Doreen, a nurse educator, described her frustration with 'trying to implement isolation policies, when there is a lack of single rooms'. She said:

> Ten years ago you would never dream of having an MRSA patient cohabiting with other patients. That happens now. In the emergency department, always there is MRSA. The ability to isolate patients, who are infected with MRSA, VRE or *C. diff*[*icile*] because of lack of beds, because of the lack of wiggle room to move around – if you are [at] 110% occupancy, where is the gap to actually make those changes?

Vincent, a physician, explained that sometimes, when over capacity, 'the best that happens is that somebody draws a curtain' between patients' beds. He went on to explain that,

> they will cohort people with antibiotic-resistant organisms with people who are not yet infected, based upon their over-capacity protocols. These people will be sharing a toilet in the four-bed room and if you really wanted to ensure spread of infection, this is exactly the way you would do it.

While individual HCAI cases can create backlogs, HCAI outbreaks can result in more serious delays. During outbreaks, surgeries were often postponed, particularly if staff became infected. Dennis, a hospital manager, described this situation of gridlock:

> With the Norwalk outbreak, we were cancelling surgical cases … and we've got big surgical waitlists … You couple that with the staff getting sick, and now you've got a real big problem on your hands because every bed is filled that we have. There is nowhere to put anybody, and we need all those staff, but they are not available, so we have to start cancelling cases and decanting the wards and try to get people out, but not fill them back up again … You are just gridlocked.

Participants reported that HCAI outbreaks also resulted in ward closures. Carter, a pharmacist, commented,

> We actually close down wards, if we have an outbreak of something that could be easily transmitted to another patient, until we have hopefully eradicated it from the area, so the access to care would be limited … It also has reduced the number of patients we can provide care to because we have some parts of the hospital closed.

The potential cost savings of investments to reduce HCAIs

Study participants argued that investments in prevention of HCAIs would result in major cost-savings given the expense of treatment, repeat procedures, and extended hospital stays. Most participants (67%) indicated that reducing HCAIs would require significant financial and personnel resources up front, but would cost less than the treatment of HCAIs. Gordon, an infection-control official, said:

> When you look at stats that state that healthcare-associated infections can cost 300 million dollars a year in our province, that's a huge, huge cost. [It is] far cheaper to spend the money [to] put in the infrastructure to reduce those rates than to keep paying for those rates … It's a conservative cost. That $300 million looks at cost of treatment, cost of extra supplies, increased length of stay, but … it doesn't at all look at all the other costs in terms of pain and suffering, loss of income, loss of mobility, [and] loss of health funds.

Some participants reasoned that major cost-savings could be achieved by hiring more infection-control staff. Muriel, a laboratory professional, argued,

> We need better infection control staff to patient ratios. We don't even meet Canadian standards here. We are working at a ratio of about 1 ICP [infection control practitioner] to 300 plus patients, where we should be 1 [ICP] to 125–150 [patients].

Incentivising hand hygiene

Many participants (60%) stated that hand-washing incentives were an important component of reducing HCAIs. Participants believed that improvements in hand hygiene rates resulted from multi-pronged incentive packages, which included hands-on champions to lead concentrated efforts, easy access and identification of hand-hygiene stations, personal and public recognition for successes, and recommendations from frontline staff to overcome barriers. Arthur, an infection-control practitioner, outlined the importance of clear expectations coupled with positive feedback and material rewards. He said, 'The incentives aren't always monetary … It is pride of workmanship. It is feedback around infection rates and it could be a celebration.'

Link nurses, ward nurses who received orientation and support from infection-prevention and control departments, led their ward colleagues through multiple practical steps to improve hand hygiene rates. Incentives included mandatory education sessions and positive recognition publicising ward nurses as hand-hygiene champions. Beverly, a nurse, described how perseverance with multiple incentives over two years led to a 70% improvement in hand-hygiene rates among nurses on her ward. After initial mandatory education for staff, link nurses reinforced the learning through informative statistics, fun activities and signage. Beverly explained:

> I've done several presentations at staff meetings on our audit result numbers, on hand hygiene stuff. The IPAC [infection prevention and control] group does an infection control results board, which gets posted into every unit in the staffroom, so [I was] drawing attention to that, actually getting people to look at the numbers.

Focused efforts from quality control personnel to remove misconceptions and barriers also motivated healthcare personnel to vastly improve their hand-hygiene compliance. Hospital manager Gloria recalled how to-the-point changes, which quickly dealt with educational gaps and physical impediments, resulted in an improvement in hand-hygiene compliance. She said:

> In the assessment room, which is where women come in labouring and they may go on to deliver, are rooms that typically have curtains around the bed and it is virtually very difficult trying to maintain those four moments of hand hygiene, so we've partnered with a group … They use lean methodology, making sure we are doing the right thing at the right time in the most efficient way … They actually stop everything, work for a week or two on trying to solve the problems … They have actually improved hand hygiene rates from before they were 30–40%, up to 85% now in the assessment room.

Incentives based on public competition or team cooperation resulted in big gains in hand-hygiene compliance. Competition bolstered hand-hygiene rates and furthered reductions in infection rates. Laboratory professional Muriel explained:

> Our hand hygiene was dismal. It was about 27% for the region when we started out, and it is now getting very close to the 80% goal that we've set as the minimum that we should do … We have a trophy and the hand hygiene reports go out every month and whoever has the best gets the trophy … I think that has contributed to some of the MRSA decrease – well a lot of it actually because we haven't had infrastructure changes … We used to be at 11.6 [MRSA cases] per 10,000 patient admissions. We've dropped that to 5.9 over three years.

More cooperative methods, which encouraged frontline staff leadership and empowerment, are growing in popularity to address barriers to hand hygiene. Positive deviance methods encouraged frontline staff to devise recommendations for overcoming barriers, compared results of similarly resourced groups within the organisation to identify success, and to replicate those positive behaviours.

Some participants indicated that physician engagement in hand-hygiene compliance was particularly challenging, which was especially concerning because physicians acted as role models for others in the healthcare system. In addition to encouragement from physician leaders for doctors to devise their own recommendations to increase their hand-hygiene rates, organisations also instituted more punitive measures to motivate physicians. Marsha, a hospital manager, noted that repeated efforts from team members to improve the compliance of individual physicians eventually met with acceptance from the doctors. She said,

> It was more huddles right there at the bedside in the ICU. That is how we did it … We just did it right there at the bedside and targeted individuals that had the gaps … [The training could be done by] the

> bedside nurse. It could be the educator – whoever happened to see them. It could be the individual doing the audit at the time and they say, 'Okay, I've been watching you and … this is where I have had to sort of say that you weren't compliant' … Sometimes at the beginning it was taken negatively, but now it is okay.

Some participants claimed that power differentials made it difficult, particularly for patients, to ask physicians or other healthcare professionals to adhere to hand-hygiene procedures. Others said they thought anonymous patient satisfaction surveys completed post-discharge would help address power differential concerns in terms of patient feedback.

The need for enhanced infection-control training

Most participants (78%) indicated that improved training for hospital staff was necessary to reduce HCAIs. Delia, an infection control practitioner, said:

> I didn't go to school that long ago, and we never talked about healthcare-associated infection. We never talked about hand-washing. I think that needs to be woven into the curriculum and then reinforced, when people come to the hospitals for either preceptorship or for orientation. It needs to be put out there that this is the culture in the hospital and these are the things we do. I think that is lacking.

Yet shortages in educators remained a challenge. Amy, an infection-control practitioner, noted, 'It is very difficult to find qualified nursing staff, infection control practitioners – there is a shortage.'

Not only was immediate access to infection-prevention and control information desirable in the initial learning stage, but some participants argued that immediate feedback was essential to correct negative actions and to sustain positive processes. Sandra, a hospital manager, contended that 'what is preventing some of our practice changes is the [poor] access to immediate feedback, and then the sharing or learning of what is best practice.'

Improving antimicrobial stewardship

Antimicrobial stewardship is the concept of using anti-infectives appropriately with the goal of optimising patient outcomes, reducing adverse events, preventing the development of resistance, and reducing healthcare costs (Dellit et al., 2007). Many participants (62%) indicated that the inappropriate use of antibiotics was detrimental to the prevention of healthcare-related infections because it may lead to the development of antibiotic-resistant organisms. Darcy, a physician, said, 'I promote antibiotic stewardship because that is an important part of infection control, and I think that that is a way of slowing down the problems with resistance.' Currently, the emergence of resistant microbes is outpacing the availability of new anti-infectives.

Overall, a shortage of resources was a described as a major barrier to the full implementation of effective antimicrobial stewardship programs. Variation in policies and practices across health authorities and institutions, and grappling with the issue of physician authority, when it came to prescribing options and patterns, were also identified as obstacles. John, a laboratory professional, highlighted the need for more resources to implement effective antimicrobial stewardship. He said:

> Our stewardship program is just starting … What has already existed in the absence of the program … is the antibiograms, so we know the resistance rates of some of our important bugs and pharmacy is tracking their antimicrobial uses for various high-cost antibiotics and doing occasional audits on their use and why. What we don't have in place is the big resource-intensive parts, which would be

> formulary restriction and the other one would be the follow-up and review of all the patients on significant antimicrobials.

Muriel, another laboratory professional, described antibiotic stewardship as,

> in its beginning stages here … The one that we have done in conjunction with the pharmacy [is] where we monitor people, who have got *C. difficile*, to make sure they are on the appropriate pathway for the appropriate length of time, but that is after the fact. They have acquired *C. difficile* because of cross-transmission and pressure of antibiotics, and we haven't addressed that front end.

Limitations in resources and lack of enforcement authority had limited the effectiveness of antimicrobial stewardship in some health authorities.

We found some variation between health authorities and institutions in this domain. Carter, a pharmacist reported:

> The Antibiotic Utilization Committee makes recommendations to the hospital and the medical staff as to what antibiotics should be available at our institution, who should have the authority to prescribe the antibiotics, and for certain antibiotics for what types of infections … We try to have a monthly meeting where we evaluate how much antibiotics are being used and try to identify trends where we see antibiotics maybe being used inappropriately and we prepare guidelines for prescribers in terms of how to utilise antibiotics. In conjunction with the microbiology lab, we monitor the sensitivities of various pathogens to our antibiotics, so if we see a trend, we could potentially alter antibiotic use.

In contrast, Muriel, a laboratory professional in another health authority, noted challenges created by physician autonomy and insufficient resources to support progressive personnel at her institution:

> For carbapenems what we do have is a step-down program, so you go to the earliest generation oral as soon as you can … but it depends upon the individual pharmacist on the ward and how aggressive they are and I think that we could be more active in making physicians justify why they need to continue. The physician just needs to say, 'I need to continue that right now.'

Muriel went on to argue that antimicrobial stewardship faced 'resistance on the part of some key physician groups, who really wish to retain the sole right to say what antimicrobials they will choose'.

Marsha, a hospital manager, contended that sufficient expert personnel were required to ensure that antimicrobial usage could be monitored and modified across all hospital wards. She said:

> Trying to determine appropriate use of antibiotics in our critically ill patient population we have recently done some audits here … One of our intensivists, in fact, is an infectious disease doctor himself … so he developed the audit and they actually did some chart reviews and the determination was that antibiotic usage was appropriate in this ICU. But unless you have an expert doing that evaluation and knowing what the patients' clinical needs were, it is really hard to do that work.

In addition to onsite experts, access to international results of appropriate antibiotic usage was a positive tool that encouraged corrective action from more resistant prescribers. Ella, a nurse educator, explained:

> One of the things in the operating room we've done is tried to get a dose of Cefazolin within that one-hour period before we cut the skin and that has been shown to reduce surgical site infections by 50%,

> so we are actually trying to get that corrected … Part of the Safer Healthcare Now initiative was that you give one dose before surgery and that you discontinue use within 24 hours unless there is a clinical reason to continue it … With our NSQIP [National Surgical Quality Improvement Program] results we are identifying people, who aren't following the criteria. At first there was a problem with some doctors, [who] would continue the antibiotics for five days … . I think we are catching – in surgery anyway – making sure that we don't give antibiotics too long.

When asked what prompted physicians to change their prescribing practices for perioperative antibiotics, Ella remarked:

> They saw the results of other people, who only gave them for a day and they were having good results. I think that is why they changed. Another thing was on our collaborative team we had a pharmacist and a pharmacist drew up a list for the types of surgeries, what antibiotic you should be using … That pharmacist was excellent and talked to them about why you only needed one dose.

Structural barriers to effective implementation of infection-control initiatives

Participants argued that critical reforms were needed to prioritise reducing HCAIs as compared to other concerns in daily practice, and within the healthcare system. Gordon, an infection-control official, reported:

> We have the high patient acuity. Everything is rushed, high stress. You've got high patient loads, you've got nursing shortages, physician shortages, all those pressures, and when you expect people to take time to stop to think: 'Am I needing to follow this practice? Am I not going to follow this practice?' Then they don't because they don't have time … You can't just provide education, if you don't provide people with the tools to actually do what you want them to do.

Some participants lobbied for additional resources from the provincial government, which funds most health care in the province of British Columbia. They also argued for more leadership and direction for initiatives to make the reduction of HCAIs a priority. Arthur, an infection-control practitioner, argued,

> I think that each individual hospital governance organisation is faced with so many priorities and so little dollars to get their work done that it is hard for them to say, 'Okay, this is where we are going to put our dollars.' There is a lot of competing priorities … When I look at the UK for example, there is some legislation around disinfection and cleaning and how that was going to be happening in hospitals and how it was going to be monitored … I think it needs to start at the top, but [be] well-resourced as well.

Certain intrinsic characteristics of HCAIs and infection control can make securing adequate sustained funding more difficult. Joel, a physician, indicated that,

> the biggest issues, in an underfunded healthcare system, [are] making infection control a priority and that's because it is not quite visible what happens when you don't clean or don't do it right. It is not as obvious as when you are cancelling cases or your ER is blocked … I think investment in infection control is important.

Discussion

Structural barriers to reform

The threat of HCAIs in Canada has rapidly become more severe, and is poised to become an even more serious threat to patient safety and the healthcare system (Gravel et al., 2009b; Simor et al.,

2010). While evidence-based programs have demonstrated that investments in infection-control programs and antimicrobial stewardship policies can reduce HCAI rates and result in cost-savings in the long run, structural barriers make it difficult to effectively implement these programs and reforms. The healthcare system must cope with growing demands from a growing and aging population, during a period in which neoliberal policy reforms have resulted in increasing calls for limiting the growth of healthcare spending (Canadian Institute for Health Information, 2012; Collier, 2012).

The study findings reveal how staffing shortages for infection-control practitioners, antimicrobial stewardship program staff, and lack of patient isolation rooms can impact HCAIs, with negative consequences for patient care and hospital operations. While improved training for hospital staff is necessary to reduce HCAIs, shortages in infection-control practitioners to provide education remained a challenge. Timely access to online infection prevention information was also inadequate due to limited availability of electronic devices at the point of care.

The findings also pointed to a lack of resources as a barrier to fully implementing formalised, funded antimicrobial stewardship programs. In some institutions, insufficient expert personnel were available to ensure that antimicrobial usage was monitored and modified to curtail inappropriate use of antibiotics, which can lead to the development of antibiotic-resistant organisms. Nascent policies and practices, and lack of enforcement authority limited the effectiveness of antimicrobial stewardship programs in some institutions. In addition, the insufficient number of private rooms, in which to isolate infected patients, created problems with patient flow, increased workload, and elevated risks of infection cross-transmission between patients.

Addressing structural barriers to reduce HCAIs in the Vancouver region

Structural changes have been shown to support improved individual compliance and reinforce behavioural modification with infection-control programs. With the complexity and volume of infection control practitioners' work increasing in proportion to increased severity, complexity and volume of illness in the patient population, recent Canadian literature supports a minimum ratio of one infection control practitioner for every 115 acute care beds (Provincial Infectious Diseases Advisory Committee, 2012). The examination of structural barriers and connections between programs and their components is important for translating research into policy and practice in hospitals (Glasgow & Emmons, 2007).

In the Vancouver region, shifting the focus to intensify initial funding for preventative measures, such as more infection prevention professionals, higher participation in quality programs, and particularly faster building of private isolation rooms, would assist in the prevention of healthcare-related infections and may prevent the morbidity and mortality secondary to HCAIs for many patients. Lower infection rates would reduce the number of patients requiring repeat surgeries due to HCAIs, decrease the frequency of ward closures from infection outbreaks, and reduce the number of beds occupied for extended periods of time by infected patients.

More leadership and resources from provincial policymakers and hospital administrators will be important to prioritise infection prevention within the healthcare system and among daily care activities. For successful change, more active leadership is needed from policymakers and senior hospital administrators to direct resources and facilitate increased time for input from frontline workers into the reform process.

The significance of antimicrobial stewardship, which is an important complement to infection-control programs, has been underemphasised. If adequately staffed and properly functioning, antimicrobial stewardship programs will reduce antibiotic pressure, promote best clinical outcomes, and reduce excessive costs due to suboptimal prescribing (Society for Healthcare Epidemiology of America, Infectious Diseases Society of America & Pediatric Infectious Diseases

Society, 2012). Initially more government resources will be needed for some hospitals to move beyond their nascent stage of antimicrobial stewardship, but most stewardship programs, which are built on recognised evidence-based guidelines, become financially self-supporting (Dellit et al., 2007). Recommended resource-intensive processes with evidence-based foundations include expert monitoring and interventional feedback to educate prescribers and improve practices. Effective antibiotic stewardship programs also include forced functions, such as formulary and prescriber restrictions.

A higher profile for infection prevention could encourage larger enrolment in formal education programs, which graduate infection prevention specialists, to address shortages in the field. In hospitals, expansion of mandatory annual infection prevention education sessions to all staff with reinforcement through immediate feedback would encourage higher compliance with best practice guidelines. Healthcare workers would benefit from point-of-care infection prevention information to align their actions with best practice guidelines. In addition, measures designed to induce peer or public pressure may be needed to persuade non-responders.

The management of HCAIs should involve funding and support from provincial governing bodies and hospital administrators, development of infection-control and prevention strategies, participation of frontline healthcare providers, and interventions through antimicrobial stewardship practices. Provincial policies should ensure that infection-control initiatives can obtain the necessary funding from hospital administrators Additional funding is required for antimicrobial stewardship programs to effectively provide prospective monitoring, feedback services and clinical practice guidelines to optimise anti-infective use and reduce the development of multi-drug resistant organisms.

Strengths and limitations

The qualitative methodology employed for this research has well-established strengths and weaknesses. For example, the sample is not a probability sample, and the goal is not to derive a list of factors or identify differences across the populations of the four subcategories. The responses may reflect social desirability bias and recall bias. The confidentiality afforded to participants is one technique to mitigate this concern. Another is the active reflexivity on the part of the researchers in all stages of the data collection and analysis, presented clearly in the publications derived from the research. The goal of this study is not to identify and prove causal mechanisms and relationships, but rather to identify important patterns of responses.

Conclusions

Structural barriers, such as staffing levels, authority, physical structure, education and policy variations, compromise the adoption and effective implementation of HCAI prevention programs and policies. The study findings show a need to intensify funding in the initial stages of programs that address preventative measures to reduce HCAIs, in particular programs to: (1) increase the number of infection-prevention professionals, (2) support higher participation of hospital workers in quality programs, and (3) increase the number of private isolation rooms. In addition, leadership and resources from policymakers and hospital administrators are necessary to expand mandatory annual infection prevention education with point-of-care follow up to align workers' actions with best practice guidelines. Policymakers also need to intensify their leadership and frontload resources to achieve fully fledged antimicrobial stewardship programs, which incorporate standardised, evidence-based clinical practice policies and guidelines.

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