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Economic Value of Norovirus Outbreak Control Measures in Healthcare Settings – A Review

NICOLE KENNY, VIROX TECHNOLOGIES INC.

Norovirus is a well-known and unwelcome visitor to healthcare facilities. The microbe is highly infectious and can spread rapidly, consuming resources and resulting in longer hospital stays. While the average cost of a nosocomial infection in the United States is approximated to be over \$15,000, there are many examples in the literature of nosocomial norovirus infections costing the healthcare system far more.



Deciding whether to implement various norovirus detection and control measures depends at least partly on the balance between the costs of implementation and the potential cost-savings from each measure. A recent study by Dr. Bruce Lee and colleagues (Economic value of norovirus outbreak control measures in healthcare settings, *Clin Microbiol Infect* 2011; 17: 640–646) sought to better understand this balance through a computer model that simulated the decision regarding whether to perform such strategies.

Modern healthcare facilities have several containment interventions at their disposal, including the interventions the authors of the article modeled: (i) increased hand hygiene with soap, water and/

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No financial support has been provided by Virox Technologies Inc. to authors of articles included in this newsletter.

Virox Tradeshow Schedule

October

October 3-4 - CIPHI Alberta Branch Fall

Workshop

October 5 - York Region Annual Education Day

October 5-7 - Annual Georgia Infection Prevention Network Conference

October 6 - CHICA- Montreal Conference

October 6-7 - CSA- Infection Prevention & Control Conference

October 12 -15 - 24th Annual International Course on Therapeutic Endoscopy

October 14 - CHICA HUPIC Education Day

October 18-21 - ISSA InterClean Conference

October 19 - Simcoe Muskoka Public Health Education Day

October 20 - Ottawa Public Health Educational Forum

October 27 - Chatham-Kent Infection Control Committee (CKICC) Conference

November

November 1, 10 & 17 - Halton Healthcare Services - 5th annual Patient Safety Expo

November 3 – Waterloo Public Health

November 3-4 - CHICA Nova Scotia Annual Education Symposium

November 3 & 18 - Toronto Invasive Bacterial Diseases Network Conference (TIBDN)

November 4 - CHICA - BC Education Day

November 24 - North Bay Public Health

December

December 14 - NSMICN Education Day

We are very excited about participating in each of these conferences & education days. We wish the best to all of the various organizers and would like to thank them for their dedication and effort in organizing these very important educational opportunities. We look forward to attending and talking to all of the participants.

Fall 2011 Virox Update

2012 Virox Patron Member Scholarship Fund

Since inception in 2003, over 100 Infection Control Professionals from across Canada have received scholarships to attend the annual CHICA Canada Conference. With tight budgets, resources for continuing education have dwindled, which compromise an Infection Prevention and Control Professional's ability to access leading edge information. Virox Technologies Inc is pleased to announce we have committed \$20,000 for the 2012 Virox Patron Scholarship Fund to ensure ICP's have access to the education they deserve. Applications are due January 31st, 2012 and will be available online www.chica.org. We look forward to seeing you at that 2012 CHICA Canada Conference in Saskatoon!

Talk Clean to Me Blog

The Professional & Technical Services (PTS) Team has recently launched a Blog, **Talk Clean to Me**. The **Talk Clean to Me** Blog was developed to clear away the haze of smoke and mirrors marketing, unravel the mysteries of disinfectant development and registration, expound the virtues in reading product labels and using disinfectants correctly, investigate the role the environment plays on infection transmission and basically educate the world or better yet the universe on everything and anything there is to do with disinfectants.

A few of our most recent blogs include:

"OMG this disinfectant kills HIV!!!!" is a statement that frequently pops up and when it does it causes many to chuckle. You see, for those of us with a rudimentary understanding of microbiology and more specifically how microorganisms interact with disinfectants, this is akin to stating that you're surprised or relieved that a 12 gauge shotgun will be effective at killing a pesky mosquito.

Premature Evaporation: Is your disinfectant fulfilling your every desire? Many would argue that the contact time of a disinfectant is the most critical element in the disinfection process. However, current practices generally only allow time for a surface to be wiped once and allowed to air dry. This begs the question – what are the potential implications of this practice when employed with commonly used disinfectant chemistries?

Scuff Off! Does a clean and scuff free floor equate to a safe and risk free hospital environment? Numerous studies conducted over the years have proven that disinfection of floors offers NO advantage over cleaning with straight detergent with respect to improvement of a facility's hospital acquired infection rate.

You Stink! What first comes to mind when you think of "clean"? Is it the smell of lemons? The fragrance of pine? Or, the overwhelming odour of chlorine? For many of us, the smell of clean is born out of what our parents used to clean our childhood homes. In reality, the true smell of clean – is no smell at all.

To sign up for our tantalizing blogs on chemical disinfectants please visit www.talkcleantome.blogspot.com or email pts@virox.com and request to be added to our email subscription list.

GREEN TEAM UPDATE ON PAGE 4

A Note from the Infection Prevention Society



Infection Prevention Society

In its 40th year, the Infection Prevention Society (IPS), the national society for British infection control professionals, continues to grow and support its members through current and emerging challenges. This year has been an exciting time within the organisation with the development of the IPS Strategy, which commenced in 2009. We are now reaching the end of a long period of consultation and collaboration with members, corporate partners and external stakeholders. This has included holding "Blue Sky" workshops, drafting vision and mission statements, using interactive feedback mechanisms during the Infection Prevention 2010 conference and discussions with IPS Consultative Committee and Special Interest Groups. Our vision is that no person is harmed by a preventable infection.



knowledge, understanding, and skills in order to reach our ultimate goal of safe and improved quality of care. The competences have been structured against four domains – clinical practice, education, research, leadership and management - and focus on outcomes of performance, in terms of what is expected of an individual when they are fully functioning at an advanced level in infection prevention. It does not matter at what level practitioners are working.

The competency framework and the support for implementation are among the key benefits of being an Infection Prevention Society member. Other benefits include:

- Free subscription to the Journal of Infection Prevention
- Professional opportunities to comment and critique national guidance and the opportunity to represent the IPS on external national working parties
- Free access to educational sessions at the Branch meeting and to British teleclass education (through Webber Training)
- Discounted rates to IPS Branch conferences and the national conference
- The opportunity for support for educational initiatives, travel awards, the Ethicon award, research awards and funding for attendance at conference

One of the Strategic Aims within the Strategy is that the IPS will lead, shape and inform the infection prevention agenda locally, nationally and internationally. To fulfil this Aim the IPS has committed to provide a framework that enables all health and social care practitioners to function competently. The outcome competences for practitioners in infection prevention and control (IPS 2011) have been developed in partnership with all four UK countries and wider stakeholders. It recognises that practitioners must continually strive to enhance existing

We officially launched the IPS Strategic Plan 2011- 2016, at the IPS conference, which was held from 19th – 21st September 2011 in Bournemouth, England. Our conference continues to attract internationally and nationally recognised speakers and the topics will prove useful for professionals working across the diverse health care settings. There's value in IPS membership regardless of where you live, and I strongly encourage you to consider joining.

Finding a Benchmark for Monitoring Hospital Cleanliness

The authors of a study, published recently in the Journal of Hospital Infection (2011 Jan;77(1):25-30), evaluated three methods for monitoring hospital cleanliness. The aim of the study was to find one or more benchmark(s) that could indicate risk to patients from a contaminated environment. The three monitoring methods included: visual inspection, ATP bioluminescence, and microbiological screening.

Five clinical surfaces were selected for testing before and after detergent-based cleaning on two wards over a four-week period, and five additional sites that were not featured in the routine domestic specification were also sampled. Measurements from all three methods were integrated and compared in order to choose appropriate levels for routine monitoring.

Visual inspection - The authors found that visual assessment did not reflect ATP values nor environmental contamination with microbial flora including *Staphylococcus aureus* and Methicillin-resistant *S. aureus* (MRSA), and was therefore an unreliable monitoring mechanism.

ATP bioluminescence - There was a relationship between microbial growth categories and the proportion of ATP values exceeding a chosen benchmark, but neither reliably predicted the presence of *S. aureus* or MRSA. ATP values were occasionally diverse. Detergent-based cleaning reduced levels of organic soil by 32% but did not necessarily eliminate indicator Staphylococci, some of which survived the cleaning process.

Microbiological screening – Through microbial sampling of the five surfaces the researchers were able to accurately and reliably determine what organisms were on the surfaces, including *S. aureus* or MRSA, and in approximate quantities. The process, however, did not permit real time feedback of cleaning efficacy.

The authors conclude that both microbiological and ATP monitoring confirmed environmental contamination, persistence of hospital pathogens and measured the effect on the environment from current cleaning practices. Helpfully, this study also suggests benchmarks to assist with future assessment of hospital cleanliness.

GREEN TEAM UPDATES

Fall arriving marks the final Virox Green Team Update for 2011. Over the past 10 months the Team has been working diligently on the Leadership in Energy and Environmental Design for Existing Buildings (LEED-EB) project and we are excited to share that we are on target to achieve the 45 points we need to submit for certification in early 2012. This is tremendously exciting for us because it will mean that ours will be the first chemical manufacturing facility to achieve LEED-EB status!!



As we have learned, LEED-EB is more than just a measurement of how much electricity, gas or water we consume. We have reviewed all of our purchasing processes from the consumables we use daily (including the food and snacks we keep in stock) to the durable goods we purchase for manufacturing our products but also the office furniture we want to purchase! For us, the easiest point was probably the Green Cleaning program that we developed thanks to the new EcoLogo certified products launched through our Accel product line in July of this year.

One of the most successful programs we have instituted is the recycling of our cardboard boxes and non-compliant skids. In past, all of our corrugate went into our recycling stream. Through this new program we have partnered with a company that reuses the boxes we receive with our packaging materials. They also refurbish the skids that we have deemed non-compliant. Reusing the cardboard boxes reduces our carbon footprint - it consumes more energy to recycle corrugate than it does to reuse it. Between May and August our Cardboard Reuse and Skid Recycling program diverted 16,020 pounds of materials from the waste stream.

If You Want the Truth, Ask the Housekeepers

FRED LEE, FRED LEE & ASSOCIATES, INC.

Anyone who saw the movie *A Few Good Men* will never forget the powerful courtroom scene at the climax of the film when Tom Cruise is pressing Jack Nicholson, a military general, to tell the truth. "You want the truth?" Nicholson snaps. "You can't handle the truth."

I sometimes think of these words when healthcare administrators talk about getting and measuring patient feedback—especially if I know that the feedback is collected only once or twice a year, or when the feedback is used only to compare themselves with other hospitals in the system, or when patient-satisfaction scores are largely unknown by the staff, or when the return on the random sample is too small to be significant, or when no money is spent on personal callbacks to, or focus groups with recently discharged patients to learn about their experience, or when the survey results do not generate any action other than trying to game the numbers by making it look like they are saying something better than they are. I want to say, "You want the truth? You can't handle the truth! Your methods are hiding the truth."

For many years we have known from numerous experiments conducted by social psychologists that there is a negative correlation between the perceived status of a questioner and the willingness of the respondent to be open and honest. A person in a position of authority is less likely to get honest, but negative comments than a person with no authority. A nurse or housekeeper may learn things the physician didn't pick up because the patient didn't want to look dumb in front of the physician.

Let's imagine that we have decided that a member of the hospital staff will be trained to elicit vital information from patients. Who is more likely to get the unvarnished truth among the following: the hospital administrator, the director of nurses, the head nurse, or a housekeeper? Intuition would tell us that it would be the housekeeper, especially if he or she has been taught to be friendly and ask how things are going. Why? Because the housekeeper has the lowest perceived status. The person least likely to get an honest response to the question "How is everybody treating you?" is probably the administrator.

When I was a vice president at Florida Hospital, for a short time we instituted something we called SHARE visits. Each vice president was expected to visit several patients a week in their rooms and ask how things were going. About all we learned from these visits was that people were exceptionally happy with their care. There were virtually no complaints.

Although I have suggested it many times, no hospital that I know of has yet embarked on a systematic way of having people who are perceived to have low status or no authority seek out complaints. Knowing the reluctance of patients to express dissatisfaction, I don't think it is too farfetched an idea to train housekeepers—or volunteers—to be the eyes and ears for spontaneous patient feedback. They would have to be trained in the proper asking techniques. They would need to learn how to empathize with the patient and ask for permission to pass on the information to the right people. Then they would need to know who gets the information and in what way. Finally, there would need to be a system for collecting, tracking, and acting on the information that is gathered. Unless these steps are all in place—the steps for actual improvement—the information should not be collected in person at the bedside at all, by anybody.

Bacterial Colonization on Writing Pens in Healthcare

LEE NESBITT, VIROX TECHNOLOGIES INC.

I was thinking the other day about what I do with my pen ... aside from writing with it that is. It was actually a shocking realization to list how often I absent-mindedly twirl it in my fingers, drop it on my desk (on the floor, on the boardroom table, on the kitchen counter, etc), throw it across my office at an offending co-worker, and among other things hold it in my mouth when a task calls for the employment of both hands. Having AHP wipes within reach everywhere I go is a nice perk of working at Virox, but one wonders about the ubiquitous pens in healthcare facilities and what they could be carrying.

A recent study by Halten et al of the University of Houston surmised that, aside from what we think of as typical hospital environmental surfaces (keyboards, telephones, toilet seats, doorknobs), this list should include writing pens as potential carriers of healthcare-associated pathogens. The purpose of their study was to assess the potential of writing pens as a source of transmission, which could be significant for hospital infection control practices when you consider the ubiquity of the instruments in healthcare facilities.

Clinical investigators enrolling patients into a study investigating antibiotic-associated diarrhea were given a new writing pen each day. Investigators were randomly assigned each day to clean the pen between patient visits while the non-intervention group did not clean the pens. After using the pen for the entire day to enroll patients, the investigators put the pen in a sterile labeled bag. Pens were then immediately transported to the laboratory. Four unused writing pens were used as controls to assure that pens were not previously contaminated with microorganisms.

Unfortunately the sample size in the study was quite small, just 23 pens (10 in the intervention group, and 13 in the non-intervention group), in addition to the four control pens. Between 2 and 11 patients touched each pen, along with the assigned investigator, and did not differ between groups. In the non-intervention group 12 of 13 pens showed bacterial growth compared with 4 of 10 pens in the intervention group. No growth was observed on control pens. Pens in the intervention group were usable for the entire day despite being repeatedly cleaned.

No Gram-negative bacilli, such as *Pseudomonas* or Family Enterobacteriaceae such as *E. coli*, were identified in either group, which tells me that the investigators were being fastidious hand washers at least for the duration of the test. There was however a significant difference in the Gram-positive cocci, presumptively identified as *Staphylococcus* spp. and *Enterococcus* spp. in the intervention compared with the non-intervention group.



Cleaning/sanitizing the pens significantly reduced the number of pens that showed visible growth on culture and reduced Gram-positive cocci, both *Staphylococcus* and *Enterococcus* spp. This is an important finding indicating that the risk of transmission of healthcare-associated pathogens can be decreased with the use of a sanitizing agent for wiping fomites such as writing pens between patients. The study authors point out that *Staph. aureus* has been demonstrated to survive on different pen types, with the longest survival time being 48h for pens with a rubber grip. The ability of bacteria to survive on pens for long durations of time emphasizes the need to clean equipment (i.e. pens) after patient contact.

Other limitations of this study include the fact that the pens were changed after just 1 day of use such that microbes did not have time to accumulate, and species identification and susceptibility typing were not carried out, which could have provided specific information on prevention of transmission of multidrug-resistant organisms. Also, it appears that the test methodology was not sufficiently sensitive to detect the presence of *Clostridium difficile* spores, which would likely have been present in this study of hospitalized patients at risk of antibiotic-associated diarrhea. Lastly, the study designers used an alcohol wipe to decontaminate the pens, certainly not recommended practice for environmental surfaces.

So what shall we conclude? I think that we can agree with the study authors that pens may be potential fomites for healthcare-associated pathogens. The risk of transmission of fomites, especially Gram-positive cocci, however, may be reduced through the regular use of a non-toxic and rapidly effective sanitizer.

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or alcohol, (ii) increased disinfection of the ward, (iii) enhanced use of protective apparel, including gloves, gowns and masks with each patient contact, (iv) staff exclusion policies, where ill staff were excluded from the workplace for an additional 2 days after symptoms resolved, increasing the nurse-to-patient ratio of the remaining staff, (v) patient isolation, where sick patients had a room to themselves, and (vi) ward closure, in which the ward halted new admissions. Each intervention has associated costs, such as an increase in materials, reduction in number of available beds, and loss of staff time and productivity.

Methods

The researchers developed a stochastic, Monte Carlo decision analytical computer simulation model with dynamic transmission elements that simulated the decision regarding whether to implement a norovirus containment intervention. Each primary and secondary patient had a probability of being symptomatic or asymptomatic. Symptomatic patients experienced an increased length-of-stay (LOS), based on published studies. This increased LOS resulted in occupied bed days that could have been used for other patients. A method described by Graves (Economics and preventing hospital-acquired infection. *Emerg Infect Dis* 2004; 10: 561–566) translated these lost bed-days to opportunity costs. Asymptomatic patients did not experience increases in LOS but could transmit the virus. Each additional secondary case added cost based on their increased LOS. The model considered costs of only primary and secondary cases.

Results

Initial simulation runs determined the cost of a norovirus case (symptomatic or asymptomatic) to the hospital: mean \$6,237, standard deviation \$3,211. Costs arose from the increased LOS from symptomatic cases that translated to lost hospital bed days.

Increased hand hygiene

Increased hand hygiene yielded net cost savings for all scenarios. For example increasing hand hygiene after detecting one primary case yielded costs of \$2,336 (10% efficacy) to \$21,394 (90% efficacy). Savings increased with the number of primary cases and intervention efficacy. Increasing hand hygiene after one primary case showed cost-savings ranging from \$4,539 (10% intervention efficacy) to \$39,748 (90% efficacy).

Increased disinfection

Increased disinfection was a cost-saving intervention as long as efficacy was >10%. With five primary cases, increased disinfection cost \$11,085 (10% efficacy) to \$99,363 (90% efficacy). Cost-savings from increased disinfection were as large as \$40,040 at 90% efficacy for even just one primary case.

Enhanced use of protective apparel

Enhanced protective apparel use was cost-saving for all scenarios. With more primary cases and increased intervention efficacy, costs decreased (by \$103,248 at 90% efficacy and five initial cases).

Staff exclusion policies

Staff exclusion policies also yielded cost-savings throughout almost every scenario. Cost-savings grew as the number of primary cases and staff exclusion efficacy increased.

Patient isolation

Patient isolation resulted in net hospital cost-savings under certain conditions. Assuming two beds per room and one primary case, patient isolation yielded cost-savings when isolation efficacy was >50%. However, as the numbers of primary cases or beds per room increased, so did net costs. Isolation with three beds per room had a net cost (i.e. expenditure) to the hospital as long as efficacy was <90% regardless of the number of primary cases. With four beds per room, patient isolation was never cost-saving, with costs ranging from \$26,724 (10% efficacy) to \$8,568 (90% efficacy). Net hospital costs persist until patient isolation becomes >20% efficacious, at which point patient isolation in a two-bed room.

Ward closure

Ward closure generated net costs for a majority of scenarios explored. Because each empty bed in a closed ward represents opportunity cost to the hospital, ward closure cost increased as the number of empty beds increased. For example, with one empty bed per ward, and ward closure initiated as soon as a single case appeared, ward closure was only cost-saving when efficacy exceeded 50%. Increasing the number of empty beds per ward to three increased hospital costs by as much as \$25,592 (10% ward closure efficacy). In general, ward closure was cost-saving only when there were no more than three empty beds.

Combined interventions

The authors of the article explored the economic effects of different combinations (bundles) of interventions and their variation with bundle efficacy (efficacy of the entire bundle together; individual strategy efficacies within the bundle can vary). The bundles that did not include patient isolation or ward closure were all cost-saving. Patient isolation bundles (two beds per room) were not cost-saving at 40% efficacy but became cost-saving when intervention efficacy was >50%. Patient isolation bundles (four beds per room) were not cost-saving at any efficacy. Ward closure plus increased disinfection with one empty bed only became cost-saving at >50% efficacy. All other bundles with ward closure were not cost-saving.

Conclusions and future directions

The authors of this article conclude by pointing out that every computer model is a simplification of real life, and no model can fully represent every event and outcome that may ensue from norovirus illness or exposure. However, using these strategies in conjunction with each other could maximize the effects of controlling an outbreak. Implementing increased hand hygiene and surface disinfection, using protective apparel, or staff exclusion policies for the control and containment of a norovirus outbreak may provide cost-savings to hospitals, while patient isolation and ward closure may be more costly, especially when not implemented early. Future studies may better elucidate the efficacy of these interventions.