The Efficacy of Body Waste Receptacles with Liner and Super Absorbent Pad in Control and Containment of Body Fluids: A Proactive Intervventional Risk Reduction Strategy

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Background
The transmissibility of pathogens including *C. difficile* spores via medical equipment in the patient environment have raised concern about the effectiveness of current methods of cleaning and disinfection of disposable and reusable bedpans and commodes.

With the introduction of a new strain (0104:H4) of *Escherichia coli*, a hyper-toxin producer, together with a continued rise in cases of *Clostridium difficile*, Methicillin-resistant *Staphylococcus aureus* (MRSA), Vancomycin-resistant *Enterococcus species* (VRE), and *Acinetobacter* and/or *Enterococcus* species over the past decade, concerns that potential contaminant debris remaining after cleaning reusable or disposable bedpans by standard methods may not be adequate.

This article questions “What is left behind?” and considers the possibility that the existing bedpan or commode may serve as a potential reservoir for pathogens.

Methods
The authors conducted a literature review and an on-line search of studies related to current cleaning and disinfection practices for bedpans. We considered the commode because it functions as a receptacle for feces and is treated in much the same way as a patient bedpan.

Results
Products designed to control and contain waste, together with recommended infection control practices, can minimize risk of cross infection and prevent potential transmission of infectious pathogens by direct or indirect contact with contaminated bedpans and commodes, thus lowering the
risk for patients and healthcare personnel. Studies indicate when engineering controls are employed in situations where patients and health personnel are exposed to body fluids or potentially infectious waste the risk of exposure is minimized using such controls. The use of hygienic bedpan covers appears to offer a viable risk reduction alternative to traditional methods of reprocessing bedpans.

Conclusion

Responding to the growing challenge of healthcare acquired infections (HAI), researchers, hospital administrators and infection control practitioners are placing increasing importance on the ability to effectively contain and control pathogens. Bedpan washers, originally designed to disinfect bedpans, do not sterilize them. As a result, spore-forming bacteria remain viable in bedpans. Studies have shown that debris remaining post cleaning leave a potential reservoir of pathogens. The single-use hygienic bedpan liner with a super absorbent pad was designed for the safe collection and disposal of human waste. The authors believe further studies on bedpan liners and absorbent pads will confirm safety and cost-effectiveness of this new and effective risk reduction, infection control tool.

Key Words

Body waste receptacles, bedpan liner, super absorbent pad, healthcare acquired infection, bedpans, engineering controls

Bedpans, urinals, and commodes are common devices found in every hospital, rehabilitation center, nursing home or long term care residence. They are designed to offer patients a socially acceptable, clean, non-infectious, non-offensive method of excreting body waste. Traditional stainless steel designs were ergonomically engineered to be comfortable for a patient during bodily evacuation while allowing the relatively safe transport of contents for disposal, cleaning and reuse.

With technological advancements, the stainless steel products were redesigned and fabricated out of a plastic material, allowing single-patient use and disposal. While plastic bedpans are more costly than reusable stainless steel bedpans in terms of medical waste generated and unit cost, the plastic devices are deemed more acceptable in terms of decreased cost for reprocessing and personnel time. Today, thousands of disposable devices, including urinals, emesis basins, bedpans and commodes, are routinely employed in patient care. The risk to caregiver and potential for environmental exposure to pathogens during transport of bedpans to a dirty utility room for reprocessing remains an infection control concern.

The safe reprocessing and effective disinfection methods currently employed include bedpan washers for reusable bedpans and macerators for disposable bedpans. These methods present a major infection control challenge because many of today’s pathogens are spore forming bacteria which remain viable after standard unit disinfection and disposal procedures. Additionally, mechanical systems do not alleviate personnel exposure to aerosolized particulates and droplets during transport, opening and closing of the bedpan washer or insertion of disposable bedpan into a macerator.

The causal relationship between inadequately cleaned bedpans and patient infection is difficult to establish, mainly due to the fact that reports of potential association between inadequate bedpan reprocessing and nosocomial infection is not often investigated as a cause when HAI is diagnosed. Inadequate reprocessing can result in the retention of feces and other biological debris allowing microbes to survive high level disinfection. It may also result in adverse patient events such as tissue irritation from residual reprocessing materials including chemical disinfectants. This increases the public health burden of HAIs in terms of morbidity, mortality and cost.

With the knowledge that poor hand hygiene and environment surface contamination also serve as a source of nosocomial spread of Acinetobacter species, Clostridium difficile, Methicillin-resistant Staphylococcus aureus (MRSA), and Vancomycin-resistant Enterococcus species (VRE), any contact with a contaminated surface or product may result in the spread of disease. While the main source of nosocomial pathogens remains the patient’s own endogenous flora, it is estimated that between 20% and 40% of HAI can be attributed to cross infection via the hands of healthcare personnel who have become
contaminated through direct patient contact or through indirect contact with contaminated environmental surfaces or products. For these pathogens to cause disease they must demonstrate certain survival characteristics or traits. Survival factors include: 1) the ability to survive and remain virulent for prolonged period on environmental services, 2) ease of transmission via contaminated hands, products or surfaces, 3) relative resistance to most common disinfectants, 4) small inoculating dose, and 5) the ability to survive and colonize in a patient.

*Clostridium difficile* infection (CDI) meets these criteria. It is a motile gram-negative anaerobe most often seen in patients who had recently used broad-spectrum antibiotics or who were exposed to the organism in the healthcare environment. When stressed, these bacteria produce spores, which tolerate extreme conditions that the active form of the bacteria cannot tolerate.

In the past few years significant changes in the epidemiologic profile of the pathogen were noted with increases ascribed to the emergence of a hyper-virulent *C. difficile* strain known as North American Pulsed Field type 1 (NAP1), restriction-enconuclease analysis (REA) type B1 or collectively known as NAP1/B1/027 strain. According to Jarvis, published literature indicates the average cost of caring for each patient with *C. difficile* infection (CDI) is approximately $4,475 per episode. It is the most frequent cause of infectious diarrhea in hospitalized patients. When *C. difficile* bacteria become overpopulated, they release toxins that can cause bloating, severe diarrhea and abdominal pain or, in some cases it may lead to pseudo-membranous colitis. CDI is associated with a 2.6 to 4.5 increase in hospital days or length of hospital stay. CDI associated mortality rates quadrupled between 1999 and 2004 with rates ranging from 6.9% at day 30 to 16.7% at month 12 post infection. Given the high morbidity and mortality associated with CDI the impact of these infections is considerable and warrant aggressive surveillance and prevention.

Of great concern is the recent appearance of (0104:H4) strain of *E. coli* in Germany. This
organism appears to be a hyper-toxin producer, which means it produces more toxins than the usual strain, and causes hemolytic uremic syndrome (a complication of an \textit{E. coli} infection that can lead to kidney failure). The morbidity and mortality rate has been estimated to be double the rate of the \textit{E. coli} O157:H7 strain found in the United States. Additionally, the toxin is carried by a bacteriophage which may migrate from strain to strain.

This organism leads to both bloody diarrhea and kidney failure, as well as resistance to 14 kinds of antibiotics instead of just one. It also lacks an adhesion gene, which means the pathogen may have found a new way to bind itself inside the body.

With the continued rise in HAIs, and with a rise in community acquired infections which may not be recognized for their virulence at the time of admission to a healthcare facility, infection control practitioners have placed greater emphasis on the need to identify and eliminate risk factors for hospitalized patients. With \textit{C. difficile}, feces pose the greatest risk for patient and worker exposure and environmental contamination. The main sources of contamination include the urinal, commode, commode handrails and the bedpan.

To help mitigate transmission of pathogenic organisms, infection control measures, including patient isolation, personal protective equipment and attire, have proven to be effective in controlling the spread of \textit{C. difficile} in the hospital setting. In addition, washing with soap and water will eliminate \textit{C. difficile} spores from contaminated hands, but alcohol-based hand rubs are ineffective.

### Engineering and Administrative Controls

The Centers for Disease Control and Prevention (CDC) published guidelines identifying two measures for controlling disease in healthcare facilities: 1) the use of engineering controls to prevent the spread of infection and reduce the concentration of potentially pathogenic organisms, and 2) the use of administrative measures to reduce the risk of cross contamination via direct or indirect contact with contaminated surfaces and droplet nuclei. Early recognition of patients who are suspected to have, or who are diagnosed with CDI is the first step in preventing the spread of this organism. Because the organism can be spread by direct and indirect contact with the patient or the patient’s environment, patients with this organism should be placed on Contact Precautions as recommended in the HICPAC/CDC Guideline for Isolation Precautions. The environment and products coming in direct contact with colonized patients are a critical source of contamination and they play a significant role in the spread of infection. Because \textit{C. difficile} is shed in feces, any surface, device or individual that becomes contaminated with feces can act as a source for infection transmission.

### Bedpans and Commodes

Contamination control is the general term for activities aimed at controlling the existence, growth and proliferation of pathogens in hospitals. Contamination control may refer to the atmosphere, surfaces, particulate matter, patient care products, infection control measures as well as decontamination and sterilization procedures. Control and containment is achieved by reducing or eradicating viable and non-viable contaminants. A major source of contaminants is improperly cleaned, disinfected or sterilized bedpans and commodes.

The design features of commodes and bedpans which insure patient comfort also create a risk that retained feces and urine often remain on the “lip” or edge of the commode or bedpan. Intrinsic in their design is a curved lip that is designed to support the buttocks and allow urination and/or defecation to be contained within the bedpan or commode pail. The underside of the “lip” feature is prone to retain debris and biological materials from splatter or splash during evacuation. When caregivers remove the bedpan or commode pail for transport to a disposal area, they can be contaminated by the contents during the disposal, cleaning and high-level disinfection process.

Hospitals and nursing homes may use a metal or stainless steel bedpan that can be decontaminated and sterilized in a clinical unit, washer-disinfector unit or sent to central processing for terminal cleaning. Plastic bedpans tend to become sticky or pitted during repeat contact with high level disinfectants, chlorine products and other disinfectant or sterilant-type agents, with resultant pitting in the plastic surface; the pits serve as a safe harbor for pathogens.

In general, bedpans are reprocessed in the following manner:

1. **First**, reprocessing begins at the point of use where the bedpan is emptied and
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gross debris. The initial cleaning is designed to prevent drying of organic soil and contaminants in and on the bedpan.
2. Second, the bedpan may be taken to a dedicated utility room or sent to central supply for cleaning, disinfection or terminal sterilization.
3. Third, the bedpan is disinfected with chemical agent or placed directly into a washer-disinfector before being routed back into use. If the bedpan is disposable it is placed in the macerator.

Whatever method is chosen, the cleaning process must insure the physical removal of organic soil, accumulation of residual debris and successful disinfection or sterilization before the item(s) are returned to the patient for repeat use. See Table 1 for clarification of terms related to bedpan liner, super absorbent pad, spores, cleaning and disinfection.

### Bacteriological Hazards of Washer-Disinfectors and Macerators

The major disadvantage of any bedpan washer-disinfector or macerator lies in the need for the healthcare worker to carry the bedpan and contents to a specified utility area or bathroom to empty the contents before any disinfection or sterilization process can occur. During this process, healthcare workers are often exposed to splatter during the emptying process. Regulations require any contact exposure posing a significant risk to patients or healthcare workers be evaluated for procedural changes and potential cost implications. Another concern is the possible transfer to worker clothing which may then serve as a source of pathogen transmission to other patients and/or healthcare personnel.

Research has shown several problems with washer-disinfectors. First, the major disadvantage of these systems is the need for a carrier or support for the bedpan. The holder or support for the bedpan is usually made of plastic or fiberglass so disinfection of the holder is a serious problem.

Secondly, the machines themselves allow the escape of live organisms into the environment during use; and because the holder is not routinely disinfected it constitutes a potential hazard to the worker placing the bedpan on the holder before it is placed in the machine. A simulated-use test of plastic and stainless steel bedpans performed by Alfa and colleagues found unit washer-disinfectors did not provide decontamination of *C. difficile* spores to a level that would ensure the bedpan was safe to handle and safe to return to use on a patient. While bedpans processed in central service were effective in killing spores, the cumulative cost of energy related to multiple hot water rinses, thermal decontamination, drying cycle as well as personnel time is significant.

### TABLE 1
Definition of Terms

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<tr>
<th>Term</th>
<th>Definition</th>
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<tr>
<td><strong>Cleaning</strong></td>
<td>The physical removal of organic soil from an item to the extent necessary for further processing or for the intended use.</td>
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<tr>
<td><strong>Disinfectant</strong></td>
<td>An agent that destroys pathogenic and other kinds of microorganisms by chemical or physical means. A disinfectant destroys most recognized pathogenic microorganisms, but not necessarily all microbial forms, such as bacterial spores.</td>
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<tr>
<td><strong>Disinfection</strong></td>
<td>A process that destroys pathogens and other microorganisms by physical or chemical means. Disinfection processes do not ensure the same margin of safety associated with sterilization processes. The lethality of the disinfection process may vary, depending on the nature of the disinfectant.</td>
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<tr>
<td><strong>Hygienic Bedpan Liner and SAP</strong></td>
<td>Patented single-use bedpan liner designed to safely collect, transport and dispose of bodily fluids, the single-use CareBag ® bedpan liner contains a super absorbent pad (SAP) that turns liquids into a gel within seconds. The patented system helps prevent the spread of potential pathogens, lessening the risk of hospital acquired infection.</td>
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<tr>
<td><strong>Reprocessing</strong></td>
<td>Validated processes used to render a previously used or contaminated medical device fit for a use on the same patient. These processes are designed to remove soil and contaminants by cleaning and to inactivate microorganisms by disinfection or sterilization.</td>
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<tr>
<td><strong>Reusable Medical Device</strong></td>
<td>A device intended for repeated use on the same patient, or with appropriate cleaning and other reprocessing and sterilization to be used on other patients.</td>
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<tr>
<td><strong>Spore</strong> (or endospore)</td>
<td>The dormant state of a microorganism, typically a bacterium or fungus, which exhibits a lack of biosynthetic activity, reduced respiratory activity, and has resistance to heat, radiation, desiccation and various chemical agents.</td>
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Standard operating procedures help users avoid errors during reprocessing. Instructions that are clear and easy to follow help assure devices are properly reprocessed and safe for reuse. When a washer-disinfector unit is employed, the unit should be tested on a regular basis to validate temperature and drying time and assure the appropriate functioning of the unit.

Education and Engineering Controls
Engineering controls are advocated in situations where health personnel may be exposed to body waste/liquids or potentially infectious waste. Studies indicate that the management of exposures to feces, urine, blood and body fluids is costly and the best way to avoid these costs is by preventing exposure. Engineering controls are used to remove a hazard or place a barrier between the worker and the hazard. The National Institute of Occupational Safety and Health (NIOSH) established a Hierarchy of Controls for worker protection, as outlined below:

Hierarchy of Controls
- Elimination of hazard
- Substitution of hazard
- Engineering controls (products)
- Administrative controls (procedures)
- Personal protective equipment (products)

The control methods at the top of the list are more effective and afford greater protection than those at the bottom of the list. Following the hierarchy normally leads to the implementation of inherently safer systems substantially reducing risk to patients and workers. While the initial cost of engineering controls can be higher than the cost of administrative controls or personal protective equipment, over the longer term, operating costs are frequently lower, and in some instances, can provide significant cost savings through exposure prevention and minimization of pathogen transmission to patients.

Removing the Risk
Prevention programs consist of routine infection prevention strategies. Contact precautions, environmental controls, adherence to hand hygiene protocols, antimicrobial stewardship, patient and staff education and administrative support help minimize the risk of transmission for practices that cannot be completely eliminated.

In 2009 the Quebec Government conducted a Comparative Analysis of Bedpan Processing Equipment. The Agence D’Evaluation des Technologies et des Modes D’Intervention en Sante (AETMIS) study was designed to:
1) establish an action plan on safe reprocessing methods for bedpans, 2) review alternative technologies and options for disposal of bedpans using a macerator, 3) assess the economic and environmental impact of existing systems, and 4) analyze the safety and effectiveness of patented hygienic bags from Cleanis Corporation.

Discussion
In light of its analysis, AETMIS concluded that using a spray wand to manually clean bedpans was a major contributing factor to increased cases of infection; hospital infection prevention and control teams need to evaluate risks associated with wands and take steps to implement engineering controls and risk reduction strategies for patient and worker protection. Where infection control initiatives were taken in C. difficile and MRSA outbreaks, lowered infection rates have been shown to reduce HAI.

The use of disposable hygienic bedpan liners with a super absorbent pad is a recent, single-use product concept that allows for the safe disposal of human waste. The system requires no equipment or infrastructure and appears to offer a significant reduction in personnel time allocated for the task. The procedure is fast, simple and requires very little staff training. Infection control teams have a key role to play in the mitigation and risk reduction strategies they institute for both patient and worker protection. The study recommended the use of the Cleanis CareBag® Bedpan liner with super absorbent pad for all patients in critical conditions, such as a C. difficile outbreak.

With rising healthcare costs, the opportunity to improve patient outcomes, lower risk of contact exposure, reduce personnel time and eliminate costs of electricity, water, equipment depreciation and reprocessing activities for bedpans, the authors believe the CareBag® bedpan liner with super absorbent pad warrants evaluation as a viable and cost-effective option for healthcare facilities. Additional studies should be undertaken to evaluate cost-in use and to confirm potential of CareBag® products to serve as an effective infection control tool.
References


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