

Titre: Implementation of a low-cost method to reduce bacterial load in patient room sink drains

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may be associated with conversion. Active COVID-19 surveillance helps early detection and decreases exposure time.

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Oral Presentation

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Evaluating N95 Respirator Filtration, Seal, Qualitative and Quantitative Fit with Vaporized Hydrogen Peroxide Reprocessing

Christina Yen; Preeti Mehrotra; Dana Pepe; Sharon Wright; Patrick Gordon and Lalitha Parameswaran

Background: The COVID-19 pandemic has created personal protective equipment (PPE) shortages, particularly of N95 respirators. Institutions have used decontamination strategies including vaporized hydrogen peroxide (VHP) to augment respirator supplies. VHP can be used to decontaminate nonporous surfaces without compromising material integrity. However, little is known about its impact on N95 respirator efficacy. We assessed whether repeated VHP reprocessing altered 4 key respirator efficacy qualities: quantitative fit, qualitative fit, seal check, and filtration rate. **Methods:** We conducted a prospective cohort study from June 15 to August 31, 2020. In total, 7 participants were fitted to a 3M 1860 small or regular N95 respirator based on qualitative and quantitative fit testing. Respirators underwent 25 disinfection cycles with the Bioquell BQ-50 VHP generator. After each cycle, participants donned and doffed respirators and performed a seal check. Participants were given 2 attempts to pass their seal check. Every 10 cycles, qualitative fit testing was done using an aerosolized Bitrex solution.

Figure 1. Change in quantitative fit test score

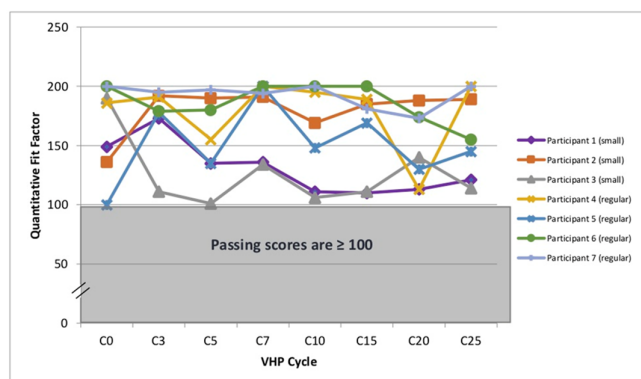


Figure 2. Change in mean filtration rate

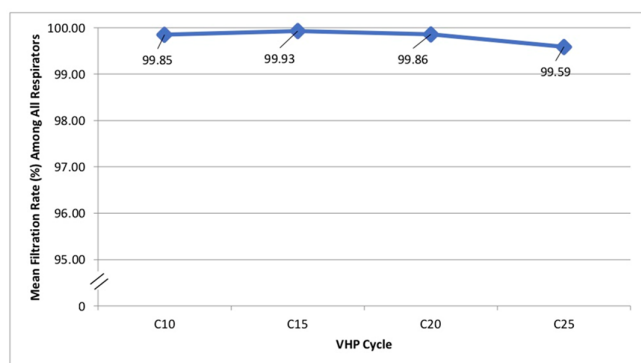


Figure 1.

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Quantitative fit testing was conducted using a PortaCount Pro 8038 Fit Tester to generate a fit factor score. Appropriate fit is defined as a fit factor score of 100 or greater. Quantitative testing was done at cycles 1, 3, 5, 7, 10, 15, 20, and 25. Filtration efficiencies of particles $\geq 0.3 \mu\text{m}$ in diameter were measured using the TSI Optical Particle Sizer 3330 at cycles 1, 5, 10, 15, 20, and 25. The Fisher exact test was used to assess qualitative fit and seal check. The Kruskal-Wallis test was used to analyze quantitative fit and filtration rate. **Results:** We observed no seal-check or quantitative-fit test failures during the study window. All participants passed qualitative fit testing. Although there was a significant degree of variability in fit factor scores across disinfection cycles (mean score 163.5, $p < 0.05$), there was no significant difference between participants ($p = 0.6$) (Figure 1). There was no statistically significant change in mean filtration rate from cycle 10 to 25 ($P = .05$), and the filtration rate remained $>95\%$ by cycle 25 (Figure 2). **Conclusions:** VHP reprocessing did not diminish the efficacy of N95 respirators based on the 4 metrics we assessed: filtration rate, seal check, qualitative fit, and quantitative fit. Of significance, the filtration rate remained well above the 95% standard filtration for N95 respirators—even through 25 cycles of reprocessing. VHP reprocessing is a safe, viable strategy to disinfect N95 respirators and extend their use, particularly during supply shortages.

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Implementation of a Low-Cost Method to Reduce Bacterial Load in Patient-Room Sink Drains

Emilie Bédard; Marie-Ève Benoit; Thibault Bourdin; Dominique Charron; Gaëlle DeLisle; Stéphane Daraiche; Sophie Gravel; Etienne Robert; Philippe Constant; Eric Déziel; Caroline Quach and Michèle Prévost

Background: Sink drains can act as breeding grounds for multidrug-resistant (MDR) bacteria, leading to outbreaks. Drains provide a protected humid environment where nutrient-rich substances are available. Recent and growing installation of water and energy conservation devices have led to increased frequency of drain blockage due to biofilm accumulation. Ineffective drainage may lead to backflow and accumulation of water in the sink during use, increasing the risk of contaminated aerosols formation or direct contamination of surrounding material and equipment. Cleaning and disinfection procedures of sink drains need to be improved to prevent amplification and dispersion of MDR bacteria. The objective of this study was to investigate alternatives to reduce the biofilm and risk of contamination through aerosols. **Methods:** Sink drains from patient rooms were randomly selected in the neonatal intensive care unit of a 450-bed pediatric hospital. We tested 4 approaches: (1) new drain; (2) self-disinfecting heating-vibration drain; (3) chemical disinfection with 20 ppm chlorine for 30 minutes; and (4) thermal disinfection with $> 90^\circ\text{C}$ water for 30 minutes. A special device was used during disinfection to increase the disinfectant contact time with the biofilm. Treatments were conducted weekly, with prior sampling of drain water. Other drains were also sampled weekly, including a control drain with no intervention. Bacterial loads were evaluated using flow cytometry and heterotrophic plate counts. The drains were made of stainless steel, a heat-conductive material. **Results:** Preliminary results show that chlorine disinfection had a small impact (<1 log) on culturable bacteria at 48 hours after disinfection but not after a week or repeated weekly disinfection. Thermal disinfection using boiling water is promising, showing an important decrease of 4 log in culturable cells after 48 hours and a concentration still $100\times$ lower 1 week after the disinfection. Repeated weekly thermal disinfection maintained lower culturable levels in the drain. No culturable cells were detected in water from the self-disinfecting drain 2 months after installation, whereas the new drain became fully colonized to concentrations similar to those of drains prior to interventions during the same period. **Conclusions:** Thermal disinfection of drains is a promising alternative

to chlorine. This solution is interesting because it is nontoxic and easy to perform, requiring a small volume of hot water. The rapid recolonization of the new drain suggests that replacing contaminated drains is not a sustainable solution and would need to be paired with a thermal disinfection program to maintain low culturable cells.

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Identification of Risk Factors for Invasive Extraintestinal Pathogenic *Escherichia coli* (ExPEC) Disease

Erik Clarke; Jeroen Geurtsen; Bart Spiessens and Christel Chehoud

Background: A pathogenic group of invasive extraintestinal pathogenic (ExPEC) *Escherichia coli* possess the ability to infect normally sterile body sites and cause severe invasive ExPEC disease (IED). ExPEC is a leading cause of bacteremia and sepsis worldwide and is associated with older age and multidrug-resistant infections. Janssen Vaccines & Prevention is developing a novel multivalent glycoconjugate vaccine to prevent IED. We aimed to use an unbiased approach, with no prespecified potential risk factors, using machine-learning models, to screen for and identify IED risk factors for further validation. **Methods:** We used a patient-level prediction study design to model the probability of a patient developing IED within 14 days to 1 year from a given date based on their prior 2 years of health records. We used the Optum EHR database (~98 million subjects) in the common data model (CDM) format, with health features encoded in the following categories: conditions, procedures, drugs, healthcare visits, recent laboratory measurements, and age and gender. A gradient boosting model (XGBoost) was used with Shapley additive explanation (SHAP) values to identify which features were most important to the model's decisions and to characterize precisely the relationship between features and outcomes (binary or continuous). **Results:** Study participants were aged ≥ 60 years at index with no previously recorded IED. Of ~6,500,000 cases included, ~8,000 had IED during the prediction window. We found that having ≥ 1 urinary tract infection (UTI) in the retrospective period increased the model's probability of predicting IED for that patient, with more frequent or more recent UTIs increasing IED prediction chance (Figure 1). Higher age linearly increased the model's likelihood of predicting that a patient would develop IED. The model also identified ≥ 1 inpatient or ER visit and laboratory values indicative of renal or immune dysfunction to be correlated with increased IED risk. This methodology is a generalizable approach to screening for potential risk factors for an outcome using EHR databases; it requires little to no prespecification of the health factors or precise relationship between the factors and outcome. **Conclusions:** Using a new, impartial methodology (with no

prespecification), older age and a history of UTIs were key predictive features for IED, factors previously identified through traditional analysis, confirming the validity of the methodology. Novel features, including recent hospitalization, were shown to increase IED risk relative to existing criteria. Our findings may be used to inform the clinical development of preventive strategies.

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Management of *Pseudomonas aeruginosa* Bloodstream Infection and Impact on Health Outcomes

Swetha Ramanathan; Margaret Fitzpatrick; Fritzie Albarilo; Katie Suda; Linda Poggensee; Amanda Vivo; Martin Evans; Makoto Jones; Nasia Safdar; Geneva Wilson and Charlesnika Evans

Background: Gram-negative bacteria cause a variety of hospital-associated infections (HAIs). Of concern is *Pseudomonas aeruginosa*, which is a leading cause of HAIs. Early and adequate therapy of *P. aeruginosa* bloodstream infection (BSI) is associated with decreased mortality. Additionally, infectious disease consultation has also shown to improve health outcomes, streamline care, and decrease costs. Therefore, the goal of this study was to describe treatment of *P. aeruginosa* BSI and impact of infectious disease consultations on health outcomes. **Methods:** In this retrospective cohort study, we analyzed national VA medical, encounter, pharmacy, microbiology, and laboratory data from January 1, 2012 to December 31, 2018. The cohort included all hospitalized adult veterans (aged ≥ 18 years) who had a positive blood culture for *P. aeruginosa*. Only the first *P. aeruginosa* blood culture per patient was included, and duplicate cultures within 30 days were removed. Treatment was identified within -2 to $+5$ days of the culture date. Multidrug-resistant (MDR) cultures were identified based on resistance to at least 1 agent in at least 3 or more antimicrobial categories tested. Multivariable logistic regression models were fit to assess infectious disease consultations and adequate treatment on in-hospital mortality and 30-day mortality. **Results:** In total, 3,256 patients had a BSI with *P. aeruginosa*, of which 386 (11.5%) were MDR. Most of these patients were male (97.5%), >65 years of age (70.9%), and non-Hispanic white (63.8%). Also, 784 patients (23.3%) died during hospitalization and 870 (25.8%) died within 30 days of their culture. In multivariable regression models, infectious disease consultations were associated with decreased odds of in-hospital mortality (odds ratio [OR], 0.64; 95% confidence interval [CI], 0.53–0.77) and 30-day mortality (OR, 0.56; 95% CI, 0.48–0.67) even after adjusting for age, race, care setting, Charlson score, and prior healthcare exposures. Furthermore, inadequate definitive treatment was associated with increased odds of in-hospital mortality (OR, 2.77; 95% CI, 1.35–5.69) and 30-day mortality (OR, 2.37; 95% CI, 1.18–4.79), even after adjusting for age, Charlson score, care setting, and prior healthcare exposures. In addition, carbapenem treatment was associated with increased odds of in-hospital mortality (OR, 1.38; 95% CI, 1.12–1.70) and 30-day mortality (OR, 1.49; 95% CI, 1.22–1.81), whereas fluoroquinolone treatment was associated with lower odds of in-hospital mortality (OR, 0.49; 95% CI, 0.41–0.59) and 30-day mortality (OR, 0.60; 95% CI, 0.50–0.71). Finally, extended-spectrum cephalosporin was also associated with lower odds of in-hospital mortality (OR, 0.82; 95% CI, 0.68–0.98). **Conclusions:** Use of infectious disease consultations and any adequate definitive treatment for those with *P. aeruginosa* BSI lowered odds of in-hospital and 30-day mortality. Early consultation with infectious disease physicians regarding adequate treatment has direct positive impact on clinical outcomes for patients with *P. aeruginosa* BSI.

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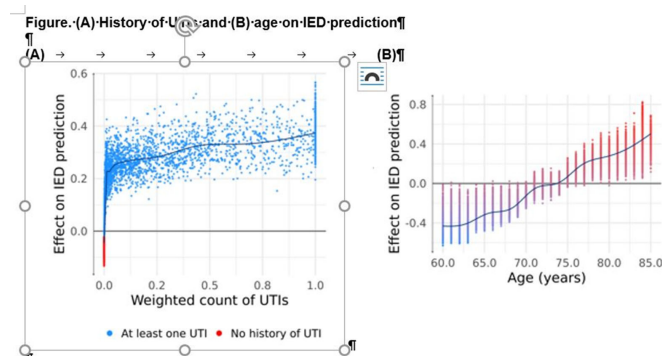


Figure 1.