Accidental and Unintentional Findings From the Midstream Clean-Catch Urine Contamination Study: Insights From Applying the Behavior Engineering Model

Over 2.6 million ED visits across the United States result in a primary diagnosis of urinary tract infection.[1] While much attention has been paid to reducing blood culture contamination rates in the emergency department,[2-9] a substantial gap remains in projects aimed at reducing contamination in clean-catch urine specimens obtained in the ED setting. Obtaining an adequate urine culture is clinically important to the care of several vulnerable patient groups, including patients with diabetes or compromised immune responses, those with high risk for subsequent urosepsis, previous antibiotic resistant infections, multiple antibiotic allergies and/or repeated infections, and older adults.[10-12] The purpose of this editorial is to 1) recognize a potential accidental and unintentional finding from a study that appears in this issue of the *Journal of Emergency Nursing (JEN),* titled "Contamination in adult midstream clean-catch urine cultures in the emergency department: A randomized controlled trial," and 2) briefly apply the Behavior Engineering Model as a tool for questions and insights on human work performance root causes of this accidental and unintentional finding.[13,14]

In this issue of *JEN*, Lough and colleagues[13] conducted a randomized controlled trial to test if a novel funnel urine collection device and silver-colloid cleaning wipe decreased urine culture mixed flora contamination. Clinical scholars often use the PICO mnemonic, for Population, Intervention, Comparison, and Outcome, to review and translate research to practice.[16] A PICO for the Lough and colleagues' study is provided here to summarize the intended research question of focus.[13] The *population* was ambulatory adults who required a midstream clean-catch urine specimen in the emergency department. The *interventions* were 1) the novel funnel urine collection system and 2) a silver colloidal cleaning wipe. The *comparison interventions* were 1) the sterile screw-top urine collection and 2) castile-soap cleaning wipe. The study included four groups to pair the two collection systems with the two genital cleaning products. The *outcome* was mixed flora contamination. The study took place in one emergency department with a pre-study contamination rate of 40%, refractory to quality improvement projects to reduce this high contamination rate. The amount of missing data regarding participants' race and ethnicity means generalizing the results to other ED sites may be challenging. The study was stopped before all the planned data collection was complete, also known as early termination. One key reason the study was stopped early was because the control group's specimen contamination rate of 30% was much lower than the site's pre-study 40% contamination rate. For those who completed the study, groups using the novel device demonstrated no difference in contamination, compared to using the traditional specimen cup. Likewise, there was no difference in contamination between the groups using the castile soap and silver colloid cleaning wipes.

The results from the Lough and colleagues[13] study have several important implications for practice, quality improvement, and ongoing research addressing meaningful solutions to midstream clean-catch urine specimen contamination rates. The importance of transparently publishing negative findings is crucial.[15] Publishing these statistically nonsignificant findings allows others to avoid using a product that may require more refinement and development, or a product that simply may not work well in the ED setting. Further, the control group's lower contamination rates, compared to the site's pre-study contamination rate, may be an accidental and unintentional discovery. It is common knowledge that a broad range of life-changing scientific discoveries, including penicillin, the microwave, X-rays, velcro, and Viagra were accidental and unintentional discoveries. Analyzing the possible reasons for the 10% reduction from the pre-study, background contamination rate of 40% at the site to the control group's 30% rate is warranted.[13] Clearly, the control group of the study did

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TABLE
Updated Behavior Engineering Model application for possible causes of 10% reduction in urine sample contamination

	Information	Resources	Incentives
Environment	Was there a change in the emergency nurses' knowledge about contamination in the samples collected in their patient assignments? Did the procedure to check fidelity to the research protocol increase the feedback and patient performance in using proper technique?	Did the educational handouts with simple anatomical drawings alone increase adherence to proper technique?	Did the involvement in an externally funded research study provide an incentive for clinical laboratory staff to analyze samples more quickly than usual? For nursing staff to reinforce proper technique with patients? For decreased transport time between patient collection and clinical laboratory? Did the knowledge that the research coordinator would check the fidelity to the research protocol provide an incentive to the patient to adhere to proper procedure?
	Knowledge/Skills	**Capacity**	**Motives**
Individual	Did the study personnel have additional knowledge and skills regarding proper technique compared to usual staff?	Did the study personnel pragmatically increase staffing and workforce capacity to educate patients on proper technique?	Were patients more motivated to use proper technique by participating in a research study, compared to participating in their usual clinical care?

Note: Refers to Lough and colleagues.[13]

not represent the usual care at the study site.[13] Applying the updated Behavior Engineering model, a tool for systematic thinking about human performance in the workplace, provides insights into several potential root causes for the change in urine contamination rates.[15]

The updated Behavior Engineering Model relays three environmental and three individual factors that affect human performance.[15] Environmental factors are 1) information, 2) resources, and 3) incentives. Individual level factors are 1) knowledge/skill, 2) capacity, and 3) motives. The Table summarizes initial analytic questions for the possible causes of the contamination rate reduction. This questioning may provide a useful example to focus future practice, quality improvement, and research interventions. It is important to note that the midstream clean-catch urine contamination rates reflect human performance at multiple levels of an organization, each of which are intricately linked: the patient, nurse, nursing unit, and hospital system (including the analyzing laboratory).

Lough and colleagues[13] anticipated that the novel device and wipes could reduce the contamination rate below 20%, which was not achieved. In applying this research to emergency nursing practice, what is a reasonable goal for contamination rates? What are the priority intervention questions, of the analyzed possibilities (Table), for ongoing testing and implementation? In a classic reference, Bekeris and colleagues[17] did identify that emergency departments had been able to achieve contamination rates of zero, which is an ideal goal. The poorest performing sites (10th percentile) demonstrated contamination rates of over 40%, for which a zero contamination rate goal might not be realistic. When categorized by 5% increments, the most frequent contamination rate was 5% to 9%, which may represent the most realistic goal for sites with contamination rates currently above this benchmark. In reviewing the practices of over 127 laboratories, the study revealed that the quality of instruction, and particularly written instructions for patients, as well as refrigerating specimens between collection and analysis were associated with lower contamination rates.[17] These results provide an important, evidence-based cue for practice, that prioritizing clear and simple written instructions for patients when collecting midstream clean-catch urine samples is indicated in the emergency department setting.

Lough and colleagues[13] provided all of their study groups with clear, one-page educational handouts with

simple anatomical drawings on the correct procedure to collect the urine sample. A sample of the handouts is printed at the conclusion of the study in this issue of *JEN*. Additional examples, from other studies, can be found online (http://luto.co.uk).[18] While there is still uncertainty if this educational handout was the causal factor in reducing the urine specimen contamination rates in the study, the handouts may provide a useful resource to augment current best-practices.[13,17] Simple patient handouts may be especially important since teaching is often the first nursing care responsibility to become de-prioritized when time or workload is compressed.[19] While simple, clear, and potentially extremely useful for practice, ongoing improvements to the handouts should be considered.[13] These handouts do not specifically address cleaning the urinary meatus site. Further, the procedure to hold the inner labia to reduce contamination for women is unclear. Likewise, the procedure to retract and clean the foreskin for uncircumcised males might be missed. Using pictorial educational material is useful and important, but addressing cultural taboos and privacy considerations for potentially offensive material and/or same- and opposite-gender communication between nurses and patients may be controversial, and require further considerations.[20]

Nurses, as the end clinical users, must be empowered and engaged in device-purchasing decisions in the emergency department. Nurse involvement in inventing, testing, and purchasing devices is essential to define efficient and cost-effective care processes.[21,22] The Lough and colleagues' study provided a powerful example of the need for nursing research to test devices in the ED setting.[13] Even though the novel device contributed to successfully reducing contamination in women in obstetric and general practice outpatient clinics,[23] more ED patient participants reported the device was difficult to use, compared to the usual screw-top collection device.[13] The funnel device was particularly difficult to use where the patient was not able to produce a forceful stream of urine. The difficulty in using the different genital cleaning wipes, due to the compactness of the wipe packaging, difficulty opening the package, and moisture of the wipe are also relevant to evaluate for patient specimen collection in other ED settings. These ED-specific, user-centered considerations are important to measure in future study.

Overall, the Lough and colleagues' study provided useful negative results to impact contamination rates for a novel urine funnel system collection device.[13] Analysis of the unexpected findings in the study reveals important implications for emergency nursing practice, quality improvement, education, and research. The educational handouts for patients on correct collection procedure may provide a particularly useful intervention to reduce specimen contamination. Further initiatives are warranted to engage nurses in all aspects of device development, testing, and site purchasing decisions as professional end users of these products.

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