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Original Article

Microbiology Section

Assessing the Impact of Educational Intervention on Staff Nurses' Knowledge, Attitude and Practice in Urine and Blood Sample Collection for Culture: A Quasi-experimental Study

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ABSTRACT

Introduction: Urinary Tract Infection (UTI) remains a common infection, with the most common Hospital-Acquired Infection (HAI) being Catheter-Associated Urinary Tract Infection (CAUTI), with overdiagnosis and overtreatment of CAUTIs and unnecessary antibiotic use. Blood Culture Contamination (BCC) is a significant quality and safety issue in hospitals, as it leads to an increase in unnecessary testing, admissions, antibiotic exposure, and cost.

Aim: To assess the Knowledge, Attitude, and Practice (KAP) of staff nurses regarding urine and blood sample collection for culture in a tertiary health care centre.

Materials and Methods: This quasi-experimental study was conducted between April 2023 and May 2023 at Siddaganga Medical College and Research Institute, Tumakuru, Southern India. A total of 148 staff nurses, all employees of the hospital, who consented to be included in the study with varied age groups and background experience, were included. Self-administered questionnaires consisting of 10 multiple-choice questions each were prepared, validated and subsequently distributed to nurses both before and after participating in an educational intervention of the microbiology department.

Results: Of the 148 participants, 129 females and 19 males, nurses demonstrated good knowledge regarding urine container use both before and after training (148; 100%), while knowledge of urine sampling during catheter change improved from 132 (89%) to 141 (95%). Knowledge regarding refrigeration of urine samples improved from 67 (45%) to 126 (85%), and disinfectant use increased from 33 (22%) to 123 (83%). In blood collection practices, knowledge of skin disinfectant use improved from 110 (74%) to 148 (100%), preferred sampling site awareness increased from 121 (82%) to 141 (95%), and knowledge regarding order of blood collection and blood draw volume improved from 38 (26%) to 126 (85%) and from 73 (49%) to 126 (85%), respectively.

Conclusion: In this study, it was found that there were gaps in the knowledge and attitude of nurses regarding urine and blood sample collection. The study identified these gaps and helped design a comprehensive ongoing educational programme for nursing staff to address these gaps. It was found that these interventions should be ongoing and inclusive of all nurses for obtaining better results on patient samples in microbiology.

Keywords: Blood culture contamination, Hospital-acquired infection, Order of draw, Questionnaire, Urinary tract infection

INTRODUCTION

Urinary Tract Infection (UTI) is a common infection, with the most common Hospital Acquired Infection (HAI) being Catheter Associated Urinary Tract Infection (CAUTI), with over a million cases in hospitals and nursing homes every year [1]. Starting antibiotic treatment without a culture and susceptibility report and collecting urine without following the correct procedure would lead to overdiagnosis and overtreatment of CAUTIs and unnecessary antibiotic use [2].

As per World Health Organisation (WHO)/Clinical and Laboratory Standards Institute (CLSI), urine sample guidelines [3], urine samples should be collected using a sterile plastic container with lid (50 mL or more) with a sterile, screw-top for easy transport ("universal" containers are often used). Outpatients should be instructed to pass urine for a few seconds to catch a midstream urine sample. It should be transported to the laboratory within 2-3 hours of collection. If this is not possible, it should not be frozen, but kept refrigerated at 2-8°C. Additionally, as per the Infectious Diseases Society of America (IDSA) guidelines [4], in patients with long-term indwelling catheters where removal is not possible, the preferred method of collecting the sample for culture is to replace the catheter and collect the sample from a freshly placed catheter. Alternatively, urine should be collected from the port; if the port is not available, then it can be collected using a sterile syringe on the tubing. This should be done after hand hygiene, donning gloves, and disinfecting the port/tubing, appropriately.

Urine culture contamination and Blood Culture Contamination (BCC) are significant quality and safety issues in hospitals, as it leads to an increase in unnecessary testing, admissions, antibiotic exposure, and cost. As blood and urine samples for culture are routinely collected by improving the knowledge of the sample collection personnel, including nurses and auxiliary nurses, can significantly decrease the rate of contamination [5].

In a comparative study consisting of one large and one medium-sized hospital, which have implemented different strategies to mitigate inappropriate antibiotic use related to BCC, it was found that BCC rates were 650 (4.1%) and 339 (4.8%), respectively, in the two hospitals. There was a three-day increase in hospital length of stay (p-value <0.001) for patients in one hospital where intravenous vancomycin was lesser compared to the other hospital where intravenous vancomycin utilisation was found to be higher emphasising the overuse of antibiotics and the length of stay of patients [6].

As per WHO, after appropriate hand hygiene and donning gloves, disinfection of the area has to be performed, and a blood sample

to be collected in the appropriate order of draw. In the paediatric age group (one year), the volume of blood to be collected for blood culture is 10-20 mL. Paired blood samples (one aerobic and one anaerobic bottle), collected during fever spikes, help in optimal recovery of microorganisms. Also, the bottles have to be labelled appropriately and sent to the lab immediately. This has to be followed by discarding the needle and gloves appropriately [3,7]. Following these guidelines yields a better-quality sample and a lower contamination rate of blood culture samples. This results in better diagnostics and impacts patient care and length of stay in hospital.

This study aimed to assess the KAP of nurses regarding blood and urine culture specimen collection before and after a structured training intervention.

MATERIALS AND METHODS

This quasi-experimental study was done in Siddaganga Medical College and Research Institute, Tumakuru, Karnataka, India between April 2023 and May 2023. Ethical approval was obtained from the Institutional Ethics Committee (Ref. No.: SMCRI/IEC/2023-24/013).

Given the time-bound nature of the study and the observed benefits of the educational intervention for both nurses and patients, the scope was expanded to include all staff nurses employed at the hospital. Consequently, 148 nurses were enrolled. No formal sample size calculation was performed, as the study aimed to include the entire available nursing staff within the specified time-frame.

Inclusion criteria: Nurses on duty from each nursing station in the hospital, those who provided consent, those on leave or on a different shift (covered in future sessions during the study period), and nurses with varying educational backgrounds and years of experience were included in the study.

Exclusion criteria: Staff unwilling to answer/unable to complete the questionnaire, and those who did not give consent were excluded from the study.

Study Procedure

An educational intervention was planned for all the staff nurses. Questionnaires were developed using relevant references and validated by faculty members from the Department of Microbiology holding MD qualifications in Microbiology with at least 10 years of teaching experience between January 2023 and February 2023. The questionnaire was pilot-tested on 20 subjects in March 2023 and was found to be reliable and validated.

The nurses attended weekly classes on a rotation basis and answered the validated questionnaire in batches. The self-administered questionnaire, which was provided in the English language, had 10 questions each for blood and urine sample collection, consisting of questions that tested the KAP of the nurses in their everyday sample collection technique [8,9].

The educational intervention was conducted by the faculty of microbiology. Both before and after (pre and post questionnaires), the same self-administered questionnaire was provided to nurses containing multiple choice questions to check their KAP of urine and blood sample collection. The responses received were graded according to the percentage of correct answers of the total as "poor" (<30%) "adequate" (30-70%) and "good" (>70%) [10].

The educational training included an introduction to the Microbiology laboratory, standard guidelines for proper sample collection, essential steps involved in specimen collection, the consequences of non-adherence to sterile techniques, and an interactive session for clarification of doubts and queries.

STATISTICAL ANALYSIS

Data were analysed using IBM Statistical Package for the Social Sciences (SPSS) 16 software. Descriptive statistics, including frequencies and percentages, were calculated.

RESULTS

A total of 148 nurses were included in the study, 129 of them were female, and 19 were male. Out of the 148 nurses, 31 were below 20 years of age, 55 were aged between 20 and 25, 56 were aged between 26 and 30, and six were aged between 31 and 35 years of age.

For urine sample collection, with the questions assessing knowledge domain, there was an improvement in knowledge on the need for refrigeration if sample transport was delayed from 67 (45%) before to 126 (85%) after the training. Likewise, with questions assessing the attitude domain, there was a change in responses in urine for culture can be collected directly from the collection bag from 49 (33%) to 115 (78%). However, there was a change in using disposable gloves for sample collection from 33 (22%) to 59 (40%), and a change in attitude of handwashing before the urine collection from 9 (6%) to 16 (11%). With the questions assessing the domain of practice, there was a change in the correct responses for collection of midstream urine from 16 (11%) to 139 (94%), and sample collection from tubing from indwelling catheters from 58 (39%) to 74 (50%) [Table/Fig-1].

Questions	Result	Pre	Post
Q1. Hand washing must be performed before collecting sample for urine culture and sensitivity. (Attitude)	Incorrect	139 (94%)	132 (89%)
	Correct	9 (6%)	16 (11%)
Q2. Sampling technique involved in collection of urine is based on discarding the first voided portion of urine. (Practice)	Incorrect	132 (89%)	9 (6%)
	Correct	16 (11%)	139 (94%)
Q3. Urine should be collected in a sterile, wide mouth, screw capped bottle. (Knowledge)	Incorrect	0	0
	Correct	148 (100%)	148 (100%)
Q4. Refrigerate urine up to 2-3 hours before sending to lab., if delayed. (Knowledge)	Incorrect	81 (55%)	22 (15%)
	Correct	67 (45%)	126 (85%)
Q5. Urine culture and sensitivity must be taken with disposable gloves. (Attitude)	Incorrect	115 (78%)	89(60%)
	Correct	33 (22%)	59 (40%)
Q6. Urine catheter tubing should not be clamped before collection of urine culture sample. (Practice)	Incorrect	58 (39%)	25 (17%)
	Correct	90 (61%)	123 (83%)
Q7. Urine culture and sensitivity sample cannot be taken directly from the urine collection bag. (Attitude)	Incorrect	99 (67%)	33 (22%)
	Correct	49 (33%)	115 (78%)
Q8. Urine from catheter can be collected from tubing with disinfection and puncturing the tubing directly with a sterile syringe with needle (Practice)	Incorrect	90 (61%)	74 (50%)
	Correct	58(39%)	74(50%)
Q9. Catheter tubing must be decontaminated with 2% Chlorhexidine in 70% alcohol before collection of urine culture sample. (Knowledge)	Incorrect	115 (78%)	25 (17%)
	Correct	33 (22%)	123 (83%)
Q10. If catheter change or removal is planned, then urine sample can be taken from the new catheter (Knowledge)	Incorrect	16 (11%)	7 (5%)
	Correct	132 (89%)	141 (95%)

[Table/Fig-1]: Pre and post-assessment (Sample collection - Urine).

With the questions assessing knowledge, there was a change in the order of draw of blood sample from 38 (26%) to 126 (85%), and total volume of blood to be collected in the paediatric age group from 73 (49%) to 126 (85%). With the questions assessing attitude, there was a change in responses to the timing of blood sample collection from 80 (54%) to 107 (72%), and preferred blood culture sampling site from 121 (82%) to 141 (95%). With the questions assessing practice, there was a change in disinfection of the blood culture cap before loading from 68 (46%) to 126 (85%) [Table/Fig-2].

DISCUSSION

This study included nurses from diverse age groups, with varying levels of experience, working across different wards. Despite these differences, all participants were assessed for blood and urine

Questions	Result	Pre	Post
Q1. While disinfecting skin during venepuncture cotton has to move - beginning in the centre and continuing in an outward direction (Practice)	Incorrect	92 (62%)	56 (38%)
	Correct	56 (38%)	92 (62%)
Q2. Disinfectant used on skin has to be left on the skin to dry for 30 seconds (Attitude)	Incorrect	38 (26%)	0
	Correct	110 (74%)	148 (100%)
Q3. Total blood sample to be collected in this order starting with blood culture and followed by vacutainers with additives (Knowledge)	Incorrect	110 (74%)	22 (15%)
	Correct	38 (26%)	126 (85%)
Q4. Total volume of blood to be collected for Blood culture in paediatric age (1 year) group is 10 - 20 mL (Knowledge)	Incorrect	75 (51%)	22 (15%)
	Correct	73 (49%)	126 (85%)
Q5. Drawing blood cultures before or during the fever spike is optimal for recovery of positive cultures (Attitude)	Incorrect	68 (46%)	41 (28%)
	Correct	80 (54%)	107 (72%)
Q6. Purpose of blood culture is to detect organisms causing blood stream infections. (Knowledge)	Incorrect	61 (41%)	46 (31%)
	Correct	87 (59%)	102 (69%)
Q7. Recommended sampling is paired samples from two different sites. (Knowledge)	Incorrect	22 (15%)	7 (5%)
	Correct	126 (85%)	141 (95%)
Q8. The recommended disinfectant for venepuncture site is Alcohol based antiseptic (Practice)	Incorrect	41 (28%)	15 (10%)
	Correct	107 (72%)	133 (90%)
Q9. Blood culture bottle top has to be disinfected with alcohol-based disinfectant before injecting blood sample (Practice)	Incorrect	80 (54%)	22 (15%)
	Correct	68 (46%)	126(85%)
Q10. The preferred sampling site for Blood culture is upper limb versus lower limb. (Attitude)	Incorrect	27 (18%)	7 (5%)
	Correct	121 (82%)	141 (95%)

[Table/Fig-2]: Pre and post assessment (sample collection - blood).

sample collection which are commonly collected samples for culture sent to the microbiology laboratory.

Regarding urine sample collection, baseline knowledge was strong for the use of appropriate collection containers (100%). However, knowledge about specimen transport during delays (>4 hours) was only adequate, with limited awareness of the need for refrigeration. This gap is clinically significant, as improper handling increases contamination rates and compromises culture quality. Following the educational intervention, correct responses improved to 85%. Evidence from a systematic review of 85 PubMed articles on diagnostic stewardship demonstrated that post-collection refrigeration reduces contamination rates by approximately 50%, underscoring its importance [11]. Similarly, another review spanning 1965-2014 recommended expedited transport, refrigeration at 2-8°C, and the use of boric acid preservatives during delays to further minimise contamination [12].

Knowledge of urine collection from catheterised patients was mixed. While most nurses correctly identified the need to collect samples from a new catheter (89%), only 22% knew the appropriate disinfection for catheter tubing, however, training improved this to 83%. Attitudes also shifted positively, with avoidance of urine collection from drainage bags increasing from 33% to 78% post-training. However, adherence to hand hygiene and glove use before sample collection remained poor, requiring additional reinforcement. A study in Malaysia reported high compliance with hand hygiene (97%) and disinfection of catheter tubing with chlorhexidine, though 15% of nurses still incorrectly believed urine could be taken from drainage bags [9]. Other studies highlight workflow pressures, patient factors (e.g., sedation, obesity), and resource barriers as contributors to non-compliance, suggesting that targeted education campaigns, guideline pocket cards, and emphasis on barrier protection can improve practice [13].

Practice improvements were noted in midstream urine collection (94%) and clamping catheter tubing (83%). However, only modest gains were achieved in collecting samples from catheter tubing (50%), indicating the need for ongoing refresher training. An Indian study comparing staff nurses and nursing students found lower knowledge among staff nurses, reinforcing the importance of continuous education [14]. Proper sampling is also critical for preventing CAUTI and Hospital-Onset Urinary Tract Infections (HOUTI). Reducing both CAUTI and non-CAUTI HOUTI has been shown to improve patient outcomes and reduce hospital-associated bacteremia and fungemia [15].

Phlebotomy and blood culture collection practices also varied. Baseline knowledge was adequate for the purpose of blood culture (59%), site of collection (82%), and paired sampling (85%). However, knowledge of paediatric blood volumes (49%) and order of draw (26%) was poor, training improved both of these to 85%. Similar gaps have been reported internationally: in Bangalore, 25.8% of nurses were unaware of the order of draw [16]; in Saudi Arabia, 40% of emergency nurses lacked knowledge of correct steps [17]; in France, 28% of nursing students were unaware of blood culture handling recommendations [18]; and in Brazil, 66% of ICU nurses did not know the required blood volume or blood-to-broth ratio [19]. In Maharashtra, only 33% of paediatric residents knew the correct blood volume for culture [20]. These findings highlight the global need for ongoing training in diagnostic stewardship.

Attitudes toward blood culture were generally positive, with good knowledge of preferred sampling sites (82%), timing (54%), and disinfectant use (72%), all of which improved after training. Multimodal interventions- including training, posters, videos, and standardised packs- have been shown to enhance adherence, reduce contamination rates, and improve diagnostic accuracy. One study reported contamination decreasing from 6.8% to 3.9% after such interventions [21]. In the present study, practice improvements were observed in skin disinfection (38% to 62%) and bottle disinfection (85% after training). These steps are critical, as contamination directly affects culture quality. Evidence shows that combined interventions targeting skin and bottle disinfection can reduce contamination rates from 3.8% to 3.1% [22].

Overall, this study demonstrated that targeted educational interventions significantly improve nurses' KAP in urine and blood sample collection. Given the rising threat of multidrug-resistant organisms, appropriate sample collection remains a cornerstone of diagnostic stewardship. High-quality specimens not only ensure reliable culture results but also directly influence patient management, morbidity, and hospital stay.

Limitation(s)

This study was conducted within a time-bound framework; therefore, no formal sample size calculation was performed. Although indirect evidence suggested a reduction in culture contaminants before and after the training sessions, the study did not include direct observation of nurses' practices in the wards. A structured checklist-based assessment of actual bedside practices would be necessary to capture this aspect more accurately. The absence of such observational data represents a key limitation of the present study.

CONCLUSION(S)

This study demonstrated that nurses working in the hospital were inadequately equipped with the knowledge but had the right attitude regarding blood and urine sample collection techniques for culture and sensitivity. In this study, it was found that regular training and informal discussions help retrain nurses and provide reminders about sample collection, given the busy schedules of these nurses. The intervention revealed the nurses' knowledge and also small steps to improve the quality of the sample and the quality of the culture report, which impacts patient care. Hence, the continuous

education of nurses for urine and blood sample collection is useful and necessary in ensuring the quality of these samples received for culture.

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