



Nurses' Knowledge of Evidence-Based Preventive Measures for Catheter-Associated Urinary Tract Infections in Kiambu County Referral Hospitals, Kenya

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Abstract

BACKGROUND

Catheter-associated urinary tract infections (CAUTIs) remain one of the most common healthcare-associated infections (HAIs) despite established preventive guidelines. Nurses play a key role in implementing prevention strategies, educating patients, and ensuring evidence-based practices. However, many lack sufficient expertise in this area. This study evaluated nurses' knowledge of evidence-based CAUTI prevention measures.

MATERIALS AND METHODS

This descriptive cross-sectional study was part of a larger quasi-experimental research. The setting was adult medical and surgical wards in Kiambu and Thika County Referral Hospitals in Kiambu County in Kenya. The census method was used to recruit 83 nurses from these wards based on pre-defined inclusion criteria. Data were collected using a pretested researcher-developed knowledge questionnaire. Data analysis was done using SPSS version 26. Descriptive and inferential statistics were used to summarize and compare the results.

RESULTS

Nurses in Kiambu and Thika county referral hospitals demonstrated poor knowledge of evidence-based measures to prevent CAUTIs. The mean knowledge scores were 57.52% (SD = 11.48) and 56.98% (SD = 10.80), respectively, with no significant difference between the two groups ($\chi^2=0.002$, $p=0.968$). Overall, 87.95% (73/83) of participants scored below the 70% pass mark, highlighting gaps across all four key areas of CAUTI prevention: appropriate catheter use, proper insertion techniques, catheter maintenance, and timely removal. Only 12.05% (10/83) met the recommended benchmark, as set by the Commission on Collegiate Nursing Education.

CONCLUSION AND RECOMMENDATION

Nurses' knowledge was poor as it was below the pass mark recommended for high-risk skills such as indwelling urinary catheter maintenance. Medical-surgical nurses should be educated on current CAUTI evidence-based prevention measures to improve their knowledge and skills and ultimately reduce these infections.

Keywords: Nurses, Knowledge, Catheter-Associated Urinary Tract Infections, Prevention.

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Introduction

Healthcare-associated infections (HAIs) affect many patients all over the world annually. Catheter-associated urinary tract infections

(CAUTIs) are among the most common HAIs. The World Health Organization defines CAUTIs as infections affecting the urinary tract and occurring in an ill person who had an indwelling urinary catheter in situ within 48 hours before the

onset of the urinary tract infection. CAUTIs are linked to an increased risk of morbidity, mortality, cost and prolonged hospitalisation. They lead to increased administrative, social, legal, financial and ethical risks for healthcare facilities if not effectively and efficiently addressed ¹. Prevention of CAUTIs is a crucial part of today's healthcare practice. The Centers for Medicare & Medicaid Services (CMS), the main health financier in the United States of America, stopped reimbursing hospitals for the treatment of CAUTI in 2008 as they identified it as one of the conditions with evidence-based prevention guidelines ². Sadly, there could be serious consequences to patients and their families should insurance companies in Kenya replicate this move.

The United States Centers for Disease Control and Prevention (CDC) along with the National Healthcare Safety Network (NHSN) in 2009 came up with evidence-based practice guidelines, strategies and standards targeting healthcare-associated infections (HAIs) among them CAUTIs ³. These 2009 guidelines have been proven to be effective for indwelling urinary catheter (IUC) management globally and they emphasise the crucial recommendations for IUC utilization, insertion practices, alternatives, and maintenance and removal practices ³. According to these guidelines and standards, IUCs must only be utilized with certain patient populations. These are patients with bladder neck obstruction; for input and output monitoring in critical care unit patients; selected perioperative patients; patients with perineal or open sacral wounds; patients with prolonged periods of immobilization, for example, those with some neurological conditions; and patients requiring end-of-life comfort. Utilization of IUC in patients with conditions outside these categories is discouraged. Moreover, IUC should only be inserted by a qualified and competent healthcare provider using aseptic techniques and sterilized equipment for all patients. Further, the IUC

should always be sealed (closed system), and the patients' flow of urine should remain unobstructed. Also, qualified health care providers, who are mindful of avoiding CAUTIs, should be allowed to maintain IUCs which must be discontinued soonest when the indication for their usage is no longer appropriate ³.

Despite the availability of these evidence-based guidelines and standards on CAUTI prevention, there has been poor compliance in their implementation among nurses in the local set-up ⁴ and, the occurrence of this condition has not reduced in recent history. The poor compliance among nurses could be attributed to a lack of current knowledge on CAUTI evidence-based preventive measures ⁴. The implementation of these evidence-based guidelines and standards by nurses in low and middle-income countries, upon sensitization through capacity-building programs, could have the potential to greatly impact reducing CAUTI rates, without needing a large expenditure of finances or resources.

Management of CAUTIs is challenging and their prevention needs an involved staff and the utilization of evidence-based preventive strategies ⁵. Nursing staff are the lead champions in promoting measures aimed at prevention, provision of patient education, and evaluation of evidence-based clinical practice strategies to reduce CAUTIs as they are the main group in the health-care system. Nursing staff working in medical-surgical wards as well as other areas of a health facility may play a crucial role in the prevention of CAUTIs.

Several studies in high-income countries have examined the effects of educational interventions and these empower nurses by increasing their knowledge, translating to a decrease in CAUTI rates ^{6,7,8}. However, very few of these studies have focused on medical-surgical wards with the majority conducted in critical care units. For instance, one study done in the USA found that 72% of CAUTI cases were reported in

non-intensive care unit patients, indicating that this inpatient population also is a key target for dedicated surveillance and infection prevention efforts ⁹.

Relating to every aspect of indwelling urinary catheter care, recommendations are that all health care professionals should have a formal update at least every five years and more often if appropriate or required ¹⁰. Given the seriousness and magnitude of the CAUTIs problem, all nurses involved in the use of IUCs must have a clear comprehension of the subject and new developments in this field. This is because most of these infections can be prevented or if they develop, can be reversed with correct and timely diagnosis and management. Therefore, there was a need to assess the knowledge of nurses on catheter-associated urinary tract infection (CAUTI) prevention as a basis for staging capacity-building programs.

Materials and Methods

Study design, setting and sample

This was a descriptive cross-sectional study. It was part of a wider quasi-experimental research study whose methodology and results have previously been discussed in part ¹¹. It was conducted in Kiambu and Thika county referral hospitals. These hospitals were purposively selected as they were the largest county referral hospitals in Kiambu county and both received the highest number of ill patients in the county. The total number of participants was 83 nurses working in the medical-surgical wards of the participating hospitals. They were selected since the main study outcome (CAUTI occurrence rates) was a unit-wide quality indicator and required all nurses who implement the preventive measures to participate in improved outcomes. The census method was used to recruit participants and this minimized selection bias. All nurses on permanent employment in the medical and surgical wards at the two participating hospitals willing to participate in the study were included. Nurses who declined to

consent to participate in the study were excluded. Following a power analysis, the sample size (n) was a minimum of 40 participants per hospital. Statistical power was determined by considering the effect size (minimum difference (d) that was clinically important) (10%), the alpha level (0.05), the standard deviation (σ) from a previous study ¹² (15%), the chosen paired-samples t-test for the pre/posttest data comparison, a desired power level (0.8) and a constant value (C) of 7.85 (at significance level 5% and 80% power). This statistical formula ¹³ was then used to calculate the required sample size (n): $(n) = 1 + 2C (\sigma / d)^2$; $(n) = 1 + 2 * 7.85 (15/10)^2$; $(n) = 1 + 35.325$; $(n) = 36.325 + 3.6325$ (considering 10% dropout); Sample size (n) = 40 nurses per hospital; Total sample size (n) = 80 nurses.

Study tools

A self-administered questionnaire was used to obtain data. There were 25 test questions grouped into four main topics: background knowledge (questions 1, 2, 3, 4, 5, 6, 21, 22, 23, 24, 25), indwelling catheter insertion (questions 7, 8, 9, 10, 11, 12), indwelling catheter maintenance (questions 13, 14, 15, 16, 17, 18) and indwelling catheter removal (questions 19, 20). These four main topics corresponded with the four components of an evidence-based CAUTI bundle ¹⁴ of care which are: reduce inappropriate use of urinary catheters, perform proper techniques for indwelling catheter insertion, implement proper catheter maintenance procedures, and remove catheters promptly.

The questionnaire was developed by the researcher drawing from literature review and its content validity verified by three experts who also improved its face validity.

Pretesting of the tool was done to ascertain its reliability where eight study tools, representing 10% of the minimum sample population, were pretested among nurses working in medical-surgical wards of Gatundu Hospital in Kiambu county. This health facility employs

similar categories of nurses and has similar patient demographics as the study sites.

Data collection procedure

The test questions in the questionnaire were marked manually and scores grouped into four main topics. Total scores were also calculated. The 25 multiple-choice questions had four responses (options a, b, c and d) where nurses were required to select one correct response for each question. Nurses who selected a correct answer were given a score of '1', and '0' for the wrong answer. Percentages were then determined for each of the four topics for every participant. Also, the total scores for each participant were expressed as a percentage. Nurses with a score of 70% and above were categorized as possessing “good knowledge”, whereas those who scored below 70% were categorized as possessing “poor knowledge” (<70=fail, ≥70=pass) according to the recommended grading scale for high-risk skills^{15, 16, 17}. These standards stipulating the pass/ fail cut, were developed following a consensus of professional nursing communities with an interest in the education and practice of nurses. They are established through: recognized accrediting agencies and professional nursing specialty organizations, national and institutional educational organizations, and health care agencies used in the education of nurses¹⁵.

Data management

Data was entered using EpiData version 3.1 and exported to SPSS version 26 for analysis. Descriptive statistics were used to analyze data on nurses' demographic information and their knowledge of CAUTI preventive measures. Results were presented in tables.

Ethical considerations

Study approval was granted by the Kenyatta University Ethics Review Committee (KU ERC (PKU/2593/11719), Kiambu County Health Research and Development Unit (KIAMBU/HRDU/22/11/07/RA_MUKIRI), Thika Level 5 Training, Research and Ethics

Committee (MOH/TKA/GEN/VOL.V/887), and Kiambu Level 5 Training, Research and Ethics Committee (KBU/STAFF.17/VOL XLIV/42) A research permit was obtained from NACOSTI (NACOSTI/P/22/20899).

A written informed consent was sought from all participants. Confidentiality of the information obtained was maintained through anonymity. Guidelines from the Ministry of Health and WHO towards the prevention and control of COVID-19 were observed.

Results

Demographic characteristics

Most nurses were females; with Thika Hospital having slightly a higher number of females (78%, n=32), compared to Kiambu Hospital (66.7%, n=28). Thika Hospital had a slightly higher number of nurses aged over 30 years (53.7%, n=22) compared to Kiambu Hospital, which had more nurses aged less than 30 years (61.9%, n=26).

The majority of nurses had a diploma in Nursing (78%, n=32 in Thika Hospital; 59.5%, n=25 in Kiambu Hospital), with a notable number (40.5%, n=17) having a Bachelor of Science in Nursing (BSc.N) in Kiambu Hospital. Similarly, the majority were senior registered nurses (SRNs) (78%, n=32 in Thika Hospital; 59.5%, n=25 in Kiambu Hospital), although Kiambu Hospital had a greater percentage of nursing officers (NOs).

Participants with more than 5 years of experience were slightly higher in Thika Hospital (53.7%, n=22) compared to Kiambu Hospital (38.1%, n=16). Finally, the majority of the nurses had no prior training in CAUTI prevention (85.4%, n=35 in Thika Hospital and 76.2%, n=32 in Kiambu Hospital).

Pearson's chi-square test for homogeneity revealed no statistically significant difference between the two hospital participants ($p > 0.05$ for all variables (the demographic characteristics). This allowed for the data from

the two study sites to be combined as indicated in Table 1.

Knowledge of CAUTI preventive measures

Background knowledge of preventive measures. An assessment of background knowledge revealed a mean background knowledge of 55.43%. Those with good knowledge (based on <70 = poor knowledge, ≥ 70 = good knowledge) were 14(16.87%). Table 2.

Knowledge of IUC insertion. This determined knowledge of the performance of proper techniques for IUC insertion. The mean knowledge of IUC insertion was 61.05%. Those possessing good knowledge were 13(15.66%) as shown in Table 2.

Knowledge of IUC maintenance. This assessed knowledge of the implementation of proper catheter maintenance procedures. The mean score was 61.05%. Those with good knowledge were 8(9.64%) as shown in Table 3.

Knowledge of IUC removal. This evaluated knowledge of timely and proper procedures for removal of IUC. The mean score was 45.18%. Those possessing good knowledge were 19(22.89%) as shown in Table 3.

Overall knowledge of CAUTI evidence-based preventive measures

This is the result of all 25 items tested regarding CAUTI prevention. The overall knowledge score for the two groups ranged from 28% to 88% with a mean score of 57.25%. Those with good knowledge were 10(12.05%) as shown in Table 4.

Association between study site, demographic characteristics and knowledge

The chi-square test of association indicated no significant association between the study sites and knowledge of nurses ($p=0.968$), suggesting that the study site did not have a statistically significant effect on nurses' overall knowledge.

Table 1:
Demographic Characteristics of Participants

		Thika		Kiambu		Both sites		p-value
		n	%	n	%	n	%	
Gender	Male	9	22.0	14	33.3%	23	27.7	0.247
	Female	32	78.0	28	66.7	60	72.3	
	Total	41	100.0	42	100.0	83	100.0	
Age	≤ 30 Yrs	19	46.3	26	61.9	45	54.2	0.155
	> 30 Yrs	22	53.7	16	38.1	38	45.8	
	Total	41	100.0	42	100.0	83	100.0	
Qualifications	$\leq$ Diploma	32	78.0	25	59.5	57	68.7	0.069
	BScN	9	22.0	17	40.5	26	31.3	
	Total	41	100.0	42	100.0	83	100.0	
Designation	$\leq$ SRN	32	78.0	25	59.5	57	68.7	0.069
	$\geq$ NO	9	22.0	17	40.5	26	31.3	
	Total	41	100.0	42	100.0	83	100.0	
Experience	≤ 5 Yrs	19	46.3	26	61.9	45	54.2	0.155
	> 5 Yrs	22	53.7	16	38.1	38	45.8	
	Total	41	100.0	42	100.0	83	100.0	
Training on CAUTI prevention	Yes	6	14.6	10	23.8	16	19.3	0.289
	No	35	85.4	32	76.2	67	80.7	
	Total	41	100.0	42	100.0	83	100.0	

Adopted from ¹¹

Chi-square tests of association and crude odds ratios were used to assess the existence and strength of the associations between nurses' knowledge of CAUTI evidence-based preventive measures and their various demographic

characteristics. There was no statistically significant association between various demographic variables and knowledge ($p > 0.05$). However, despite this lack of association, crude odds ratios revealed some trends.

Table 2:

Background on CAUTI Prevention and IUC Insertion Knowledge

	Background knowledge of CAUTI prevention			Knowledge of IUC insertion		
	Kiambu	Thika	Both sites	Kiambu	Thika	Both sites
Mean	54.77	56.10	55.43	62.30	59.76	61.05
Median	54.55	54.55	54.55	66.67	66.67	66.67
Mode	45.45	54.55	54.55	66.67	66.67	66.67
Std. Deviation	13.70	15.73	14.66	19.50	13.42	16.72
Variance	187.63	247.42	214.95	380.20	180.23	279.66
Range	63.64	72.73	72.73	100.00	50.00	100.00
Minimum	27.27	18.18	18.18	0.00	33.33	0.00
Maximum	90.91	90.91	90.91	100.00	83.33	100.00
Sum	2300.35	2299.95	4600.30	2616.71	2450.03	5066.74
Good knowledge	5(11.9%)	9(22%)	14(16.87%)	8(19%)	5(12.2%)	13(15.66%)
Poor knowledge	37(88.1%)	32(78%)	69(83.13%)	34(81%)	36(87.8%)	70(84.34%)

Table 3:

Knowledge of IUC Maintenance and Removal

	Knowledge of IUC maintenance			Knowledge of IUC removal		
	Kiambu	Thika	Both sites	Kiambu	Thika	Both sites
Mean	62.30	59.76	61.05	45.24	45.12	45.18
Median	66.67	66.67	66.67	50.00	50.00	50.00
Mode	66.67	66.67	66.67	50.00	50.00	50.00
Std. Deviation	17.29	13.43	15.46	36.31	38.41	37.13
Variance	298.92	180.25	239.03	1318.24	1475.61	1378.93
Range	100.00	50.00	100.00	100.00	100.00	100.00
Minimum	0.00	33.33	0.00	0.00	0.00	0.00
Maximum	100.00	83.33	100.00	100.00	100.00	100.00
Sum	2616.74	2450.05	5066.79	1900.00	1850.00	3750.00
Good knowledge	5(11.9%)	3(7.3%)	8(9.64%)	9(21.4%)	10(24.4%)	19(22.89%)
Poor knowledge	37(88.1%)	38(92.7%)	75(90.36%)	33(78.6%)	31(75.6%)	64(77.11%)

Table 4

Overall knowledge of CAUTI prevention

	Kiambu	Thika	Both sites
Mean	57.52	56.98	57.25
Median	56.00	60.00	56.00
Mode	56.00	60.00	60.00
Std. Deviation	11.48	10.80	11.09
Variance	131.87	116.62	122.90
Range	60.00	48.00	60.00
Minimum	28.00	28.00	28.00
Maximum	88.00	76.00	88.00
Sum	2416.00	2336.00	4752.00
Good knowledge	5(11.9%)	5(12.2%)	10(12.05%)
Poor knowledge	37(88.1%)	36(87.8%)	73(87.95%)

The odds of being knowledgeable were lower among nurses in Kiambu Hospital compared to those in Thika Hospital (COR = 0.973, 95% CI [0.259 - 3.649], $p = 0.968$), higher among female nurses compared to male nurses (COR = 1.615, 95% CI [0.316 - 8.247], $p = 0.561$), lower among nurses aged above 30 years compared to those below (COR = 0.765, 95% CI [0.199 - 2.938], $p = 0.696$), lower among BScN compared to diploma holders (COR = 0.932, 95% CI [0.221 - 3.932], $p = 0.923$), lower among nurses designated as NOs compared to SRNs (COR = 0.932, 95% CI [0.221 - 3.932], $p = 0.923$), and higher among nurses with more than five years of experience compared to those with less (COR = 1.212, 95% CI [0.323 - 4.549], $p = 0.775$) as displayed in Table 5.

Discussion

The mean overall nurse's knowledge of catheter-associated urinary tract infection (CAUTI) preventive measures was 57.25%. This was poor knowledge as per recommendations by the

Commission on Collegiate Nursing Education¹⁵. Only a small proportion of nurses ($n=10$, 12.05%) had good knowledge. These findings are comparable to a similar study done in India which assessed the knowledge and attitude of healthcare providers about catheter indications and CAUTI prevention methods and found that nurses had low levels of knowledge regarding indwelling urinary catheter (IUC) care, its indications and preventive measures¹⁸. These findings also are comparable to those of a study done in Rwanda which revealed that the overall knowledge of nurses on CAUTI preventive measures was poor at 64.52%¹⁹.

Nurses' knowledge base on CAUTI prevention was lacking, therefore, infection rates of zero in medical-surgical units of the study sites may never be realized until capacity-building targeting the nurses is put into effect. Poor performance was noted in all four main topics corresponding with the four components of an evidence-based CAUTI bundle of care that were assessed.

Table 5:

Association Between Study Site, Demographic Characteristics, and Knowledge of Nurses on CAUTI Evidence-Based Preventive Measures

Variable	Category	Knowledge			χ^2	COR (95% CI)	p-value
		No (n, %)	Yes (n, %)	Total (n, %)			
Study Site	Thika Hospital	36 (49.3)	5 (50.0)	41 (49.4)	0.002	0.973(0.259-3.649)	0.968
	Kiambu Hospital	37 (50.7)	5 (50.0)	42 (50.6)			
Gender	Male	21 (28.8)	2 (20.0)	23 (27.7)	0.337	1.615(0.316-8.247)	0.561
	Female	52 (71.2)	8 (80.0)	60 (72.3)			
Age	≤30 years	39 (53.4)	6 (60.0)	45 (54.2)	0.153	0.765(0.199-2.938)	0.696
	>30 years	34 (46.6)	4 (40.0)	38 (45.8)			
Qualifications	≤Diploma	50 (68.5)	7 (70.0)	57 (68.7)	0.009	0.932(0.221-3.932)	0.923
	BScN	23 (31.5)	3 (30.0)	26 (31.3)			
Designation	≤SRN	50 (68.5)	7 (70.0)	57 (68.7)	0.009	0.932(0.221-3.932)	0.923
	≥NO	23 (31.5)	3 (30.0)	26 (31.3)			
Experience	≤5 years	40 (54.8)	5 (50.0)	45 (54.2)	0.081	1.212(0.323-4.549)	0.775
	>5 years	33 (45.2)	5 (50.0)	38 (45.8)			
Training on CAUTI Prevention	Yes	14 (19.2)	2 (20.0)	16 (19.3)	0.004	0.949(0.181-4.969)	0.951
	No	59 (80.8)	8 (80.0)	67 (80.7)			

Legend: χ^2 , chi-square; COR, crude odds ratio; CI, confidence interval; CAUTI, catheter-associated urinary tract infections.

Assessment of background knowledge, corresponding with reduction of inappropriate use of the IUC component of the bundle, yielded poor knowledge as the mean was 55.43% with only 14(16.87%) categorized as possessing good knowledge. This is congruent with a study done in Rwanda which reported nurses' mean knowledge regarding inappropriate indications of IUCs at 52.8%¹⁹. This, also, echoes a study done in Kenya where nurses were not aware of the inappropriate indications for urethral catheterization¹⁷. Nurses, being the main players in activities occurring in the 'lifecycle' of Foley catheters, need to be equipped with knowledge on indications for IUCs to ensure that inappropriate ones are discontinued promptly and/or not inserted at all.

Knowledge of the performance of proper techniques for IUC insertion was another component of the bundle that was assessed. The aspects examined were: sterile insertion, routine use of antiseptic lubricants, hand hygiene, persons tasked with insertion, securement and selection of appropriate bore/catheter size. The study unveiled mean knowledge on IUC insertion as 61.05% whereas those possessing good knowledge were 13(15.66%). This is contrary to findings from a study carried out in Kenya where most participants (71%) possessed good knowledge levels of evidence-based CAUTI prevention guidelines on IUC insertion¹⁷. To reduce the risk of CAUTI acquisition, nurses are required to have adequate knowledge of basic preventive measures such as aseptic technique and hand hygiene. They require updates on current practices regarding securement and use of antiseptic lubricants on IUCs.

The third component assessed was knowledge of the implementation of proper catheter maintenance procedures. This tested maintenance of a closed drainage system and unobstructed urine flow, positioning and emptying of collecting bags, and meatal care. Here, the mean score was 61.05% and

75(90.36%) participants had poor knowledge. The results are consistent with those found in similar studies where nurses had low scores concerning catheter care, cleaning the meatus and emptying drainage bag^{19, 20}. Nurses are responsible for the management of IUCs, hence, they need to have current updates on their management aspects to achieve zero CAUTI rates.

Knowledge of timely and proper procedures for removal of IUC was the last component assessed. The mean score was 45.18% where a majority of nurses had poor knowledge. Early removal of IUCs has been shown to reduce CAUTI rates. This is possible if nurses are knowledgeable on the frequency of assessing patients to determine whether appropriate criteria are met for continuation of IUC use and proper techniques for removal.

In this study, there was no statistically significant association between various demographic variables and knowledge status ($p > 0.05$). This is further supported by similar studies that reported no association between nurses' knowledge scores and socio-demographic variables^{7, 21}.

In all healthcare settings, nurses have the greatest responsibility in avoiding the insertion of unnecessary IUCs, managing catheters and reducing the duration of catheterization, emptying the urine collecting bags regularly and performing all other activities revolving around the 'Foley catheter life cycle'. These activities, forming part of a high-risk skill, therefore, require nurses to have good knowledge of them.

Study Limitation

Data collection was from only two county referral Hospitals; thus, this study's findings may not be generalizable to other hospitals.

Conclusion

The nurses' knowledge of catheter-associated urinary tract infection CAUTI

preventive measures was poor. Most nurses had a knowledge deficit in all the four main areas assessed concerning the prevention of CAUTIs: knowledge of timely and proper procedures for removal was the poorest among the four care bundle areas. Dwelling of catheters beyond their necessity is one of the main drivers of healthcare-associated infections. There were no differences in knowledge between the study sites.

Recommendations

Continuing medical training on current CAUTI evidence-based prevention measures needs improvement for medical-surgical nurses. This will keep them up-to-date with the new concepts and enhance their knowledge and practices in order to achieve zero infection rates.

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