ORIGINAL ARTICLE

Assessment of Knowledge, Attitude, and Practice on Risk of Acute Kidney Injury among Surgical Nurses at a Public Teaching Hospital, Kuala Lumpur, Malaysia

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ABSTRACT

Introduction: Acute Kidney Injury (AKI) is frequently discussed in ICU settings, but there's a dearth of data on its incidence among surgical patients in Malaysia. Understanding AKI onset characteristics and prognostic risk factors is crucial for enhancing clinical prevention and treatment strategies. Adequate knowledge among nurses, especially in early recognition, is key to identifying and preventing AKI in at-risk patients. This study aimed to assess the Knowledge, Attitude, and Practice (KAP) of nursing risk assessment regarding AKI among surgical department nurses.
Methods: A quantitative, cross-sectional study was conducted in a Kuala Lumpur public teaching hospital from June 30th to July 8th, 2022. Seventy-five nurses from various units in the surgical department were randomly selected. Their KAP on AKI was evaluated using self-administered questionnaires, developed and validated for this research.
Results: Most respondents were female nurses with a mean age of 35.7 and an average nursing experience of 9.78 years. Thirty-three nurses had advanced clinical training, and 21.3% had critical care unit experience. Overall, the KAP level on AKI among surgical nurses was moderate (61.4%). Significant differences in KAP scores were observed among different working units (p=0.031) and among nurses with advanced training (p=0.019). Notably, while nurses showed good knowledge and practice in AKI risk assessment, 93.3% were unable to correctly define AKI, and 70.7% lacked knowledge in performing AKI risk assessment. Additionally, only 2.6% correctly identified AKI risk factors.
Conclusion: Nurses' KAP scores on AKI in the surgical department were moderate. Implementing an education program on AKI risk assessment for nurses is essential to enhance their ability to identify and manage AKI in surgical patients.
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INTRODUCTION

The incidence of Acute Kidney Injury (AKI) has been reported in significant studies incorporated with varying geographic locations, demographics, diagnostic standards and clinical practice. Globally, AKI represents a multifaceted challenge, affecting millions of individuals across continents. High-income countries grapple with cases arising from advanced medical interventions and an aging population, whereas in low- and middle-income regions, AKI often intertwines with challenges related to infectious diseases and limited healthcare access (1). Recent meta-analyses found that the incidence of AKI measured using the Kidney Disease Improving Global Outcomes (KDIGO)-equivalent criteria was 19.4% in Eastern Asia, 7.5% in Southern Asia, 31.0% in Southeast Asia, 9.0% in Central Asia and 16.7% in Western Asia. These incidence rates were based on hospitalised population (2). It should be noted that these incidences were much higher than those from general hospitalized populations, as most studies involved patients with severe conditions such as cardiac surgery, tumours or intensive care unit (ICU) patients (3). Meanwhile, AKI statistics in Malaysia from 2014 to 2016 displayed an increasing trend of mortality caused within 24 hours of ICU admission (4) . A prospective observational study measuring AKI complications among

hospitalized patients in Malaysia reported that 65.0% of 143 patients had AKI, 38.0% were classified as AKI based on creatinine, 61% as AKI based on urine output criteria, as well as 34% as AKI based on creatinine and urine output criteria. From the study, it was observed that AKI is an independent risk factor for mortality, with a hazard ratio of 2.61 [1.06-6.42] (5) . According to the current Kidney Disease Improving Global Outcomes (KDIGO) definition and staging system for AKI includes three stages. In stage 1, AKI is confirmed if the creatinine level is ≥1.5 times the baseline or there is an increase of ≥0.3 mg/dL within any 48-hour period. In stage 2, AKI is confirmed if the creatinine level is ≥2.0 times the baseline or the urine volume is <0.5 mL/kg for ≥12 hours. In stage 3, AKI is confirmed if the creatinine level is ≥3.0 times the baseline, increases to ≥4.0 mg/dL, or if acute dialysis is required, or if the urine volume is <0.3 mL/kg for ≥24 hours (6,7). This clinical parameter has been associated with complications and linked to adverse outcomes including death (8). The incidence of AKI in Malaysia reflects a dynamic interplay between non-communicable diseases such as diabetes and hypertension, and communicable diseases prevalent in tropical climates. The distinct epidemiological profile, coupled with variations in healthcare resources and awareness, underscores the need for context-specific approaches to AKI prevention, early recognition, and management (5). By juxtaposing the global scenario with the intricacies of the Malaysian healthcare landscape, this study aimed to shed light on the nuanced challenges faced by healthcare practitioners in tackling AKI within the country.

AKI has been constantly discussed in ICU settings; however, findings on the incidence of AKI reported among surgical patients were still inadequate, particularly in Malaysia. For example, an observational cohort study in the United States reported post-operative AKI that occurred in 11.8% of 161,185 major surgeries requiring hospitalization. In the study, cardiac surgery recorded the highest post-operative AKI risk compared to other surgeries. Based on the findings, AKI commonly develops after major surgery with similar risk factors and outcomes interrelated with the type of surgery performed (9). The prevention and treatment of AKI can be improved by providing a better understanding of the onset features of the condition and the risk factors linked to its prognosis. However, there is still an unacceptable lack of information and comprehension of AKI development among medical professionals, including physicians and nurses. A study in Nigeria discovered that only 1.2% of non-nephrology doctors in government hospitals with good knowledge of AKI, while 69.2% of them had fair knowledge (10). Similarly, a study in Malawi revealed that nursing staff also have a lack of knowledge and understanding in recognising patients with AKI as they failed to recognise the patients presented with signs and symptoms of AKI. As a result, the patients developed an advanced phase of AKI due to late referral (11). The knowledge gap among surgical nurses regarding AKI could have a substantial and diverse impact. It may result in delayed recognition and diagnosis of the condition, which is crucial for timely implementation of suitable interventions to prevent additional kidney damage and enhance patient outcomes (12). If nurses are unaware of the early signs of AKI, they might not be able to identify subtle changes in a patient's condition that could indicate the onset of AKI. This delay in recognition and diagnosis can lead to missed opportunities for timely interventions. As a result, the AKI might progress without appropriate management, potentially exacerbating the severity of the condition and increasing the risk of complications such as mortality or prolonged hospitalization. A previous study related to AKI complications observed that AKI is common and is linked to longer hospital stays and higher mortality. Researcher suggested that detecting minor AKI signs early is crucial, especially for older patients (13). A lack of knowledge regarding AKI can result in improper management and care of patients. There were only a few interventions on taking serum creatinine to the patient's admission due to a lack of knowledge and awareness to assess the abnormal kidney function and the development of AKI as reported by Evan, 2015 (14) in an audit performed among Malawians.

A study pertaining nurses KAP related to kidney disease indicated that the majority of participants possessed knowledge regarding kidney disease, albeit approximately half of them held misconceptions concerning the signs and symptoms associated the kidney disease (15). Therefore, there is a pressing need to enhance the nurses understanding of kidney disease to elevate knowledge, awareness and promote informed behaviors, ultimately leading to improved delivery of care. Furthermore, awareness of the prevention of AKI among hospitalised patients through staff education programs remains scarce. Limited studies on detecting AKI through risk factors and clinical manifestations have not adequately been discussed among nurses, especially in Malaysia. Therefore, the present study aimed to assess the KAP of nursing risk assessment on AKI towards surgical department nurses. While the specific objectives were to determine the level of KAP among surgical department nurses regarding the various risk factors associated with AKI. In addition, the KAP of surgical department nurses toward the understanding of AKI was analyzed.

MATERIALS AND METHODS

Research design and setting

A quantitative, cross-sectional study was conducted from June 30th to July 8th, 2022, involving ten units within the surgical department at Hospital Canselor Tuanku Muhriz, Kuala Lumpur, Malaysia (HCTM). These units included a male general surgery ward, female general surgery ward, urology, neurosurgery, ophthalmology,

cardiothoracic, plastic and Ear, Nose and Throat (ENT) wards, High Dependency Unit (HDS), Burn Unit, and Cardiothoracic Intensive Care Unit (CICU).

Study sample

The study population comprised 105 registered nurses working in the surgical department of (HCTM). Fifteen nurses were excluded from this study as they were on long leave such as maternity, study and unpaid leaves, and planning for work retirement/resignation. Based on the Raosoft sample size calculation considering 5% standard error, 50% response distribution and 95% confidence interval, the recommended and adequate sample size was 75 out of 90 nurses. Therefore, a probability (proportional stratified random sampling) of 75 registered nurses were randomly selected following criteria of at least 1-year working experience whether permanent or contract staff nurses were entitled to participate in this study. The participants should currently be working in the surgery department. Meanwhile, attachment nurses or nursing students who were temporary workers in the surgical department were excluded from this study.

Research tool

The KAP survey on AKI included 30 questions divided into four sections: Section A provided demographic information of respondents. Section B assessed the respondents' knowledge of AKI. This section included 15 items on clinical features, types and risk factors of AKI, potentially nephrotoxic medications, criteria for diagnosis and staging of AKI, newer biomarkers and indications for renal replacement therapy in AKI. The questions in this section were developed based on a study by Adejumo et al. (2017) (10). Section C consisted of 7 questions on the domain of practice to determine nurses' practice in identifying AKI through risk assessment adapted from Venous Thrombo-Embolism knowledge, risk assessment practices, perceived barriers to risk assessment and prevention self-efficacy (16). There was a combination of YES-NO and multiple-selection answers. Section D was the final section of the questionnaire consisting of 8 items for the attitude domain that requires nurses to rate their attitude based on a 5-point Likert Scale regarding the delivery of care towards patients based on knowledge and clinical skills of AKI. The questions were developed and adapted from Kirwan et al., 2016 (13).

The instrument was put under the content validity process involving four experts mainly a surgeon, a nephrologist, a nursing academician and an experienced nurse with a minimum of a master's educational level. The overall Content Validity Index value for KAP on AKI questionnaire was 0.96 indicating an adequate standard of acceptability. Overall Cronbach's Alpha value was at 0.81. The KAP on AKI questionnaire is a valid tool to assess nurses' KAP levels, respectively (17).

Ethical considerations

Ethical approval was obtained from Universiti Kebangsaan Malaysia (UKM) Research Ethics Committee and the Director's Office HCTM (Ethic reference number: UKM PPI/111/8/JEP-2022-161). On top of that, in addition, the researchers had a meeting with the head of training and development unit nursing department to obtain permission to conduct this study.

Data collection procedure

This study, one nursing representative from the surgery department was appointed to provide a list of names from 10 surgical units. Seventy-five names in all the units were collected and given by the representative. Later, a research code was created inclusive of working unit and participant code for each participant to avoid confusion and error. The participants were requested to sign the consent form attached to the questionnaire to provide evidence of voluntary participation. The participants who agreed and met the inclusion criteria for this study were given a participants Information Sheet containing the objectives of this study. Anonymity and their rights to withdraw at any time without penalty were ensured. The KAP on AKI survey questionnaire was distributed from 30th June 2022 and participants were asked to complete and submit the survey within 1 week.

Data analysis

The quantitative data were analyzed using the Statistical Analysis for Social Sciences (SPSS) version 26. All the significant values were set at $p<0.05$ with a 95% confidence interval. For nurses' characteristics, the level of KAP and the total score of each domain were measured by percentage and frequency. Meanwhile, in determining the relationship between nurses' characteristics and KAP score, the Pearson correlation was used in this study. To determine the association between nurses' characteristics and KAP scores, the linear regression test was utilised in this statistical analysis.

RESULTS

Seventy-five respondents completed and returned the survey with a 100% response rate. The respondents were surgical nurses who worked in 10 different units in the surgical department comprising Male General Surgery ward= 11 (14.7%), Female General Surgery ward= 10 (13.3%), Neurosurgery ward= 9 (12.7%), Urology ward= 8 (10.7%), multi-discipline of Plastic/maxillofacial/ENT surgery ward= 7 (9.3%), Burn Unit, Ophthalmology and Cardiothoracic ward, High Dependency Unit (HDS) and Cardiothoracic Intensive Care Unit (CICU) contributing to 6 (8.0%) respondents each (Fig. 1a). The mean age and standard deviation of the respondents were 35.7 (5.30) years. The majority of the participants were female nurses representing 96.0% while male nurses were at 4.0%. Most respondents were

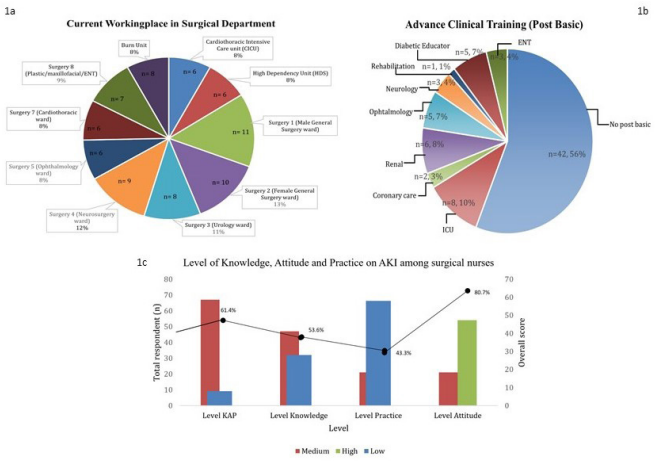

Figure 1: Distribution of advance clinical training (post-basic) (1a), distribution of current workplace surgical department (1b) and the overall level of knowledge, attitude, and practice of AKI among respondents (1c).

diploma holders (n=62), followed by degree holders (n=13). The mean of nursing working experience was 9.78 (5.57) ranging from 1 to more than 21 years. The details of the respondents' characteristics are displayed in Table I.

There were 33 (44.0%) of the respondents who received their Advance Clinical Training (Post Basic) inclusive of critical care (ICU) by 10.0%, renal by 8.0%, diabetic educator and ophthalmology by 7% each, neurology and ENT by 4.0% each, coronary care by 3.0% and rehabilitation advance training by 1.0% (Fig. 1b). Respondents who claimed that they had working experience in the medical unit were 21.3% and 29.3% of the respondents had experience working in the critical care unit throughout their job duration.

A total of 30 items from KAP of AKI survey were used to measure the level of KAP of AKI among surgical nurses. Figure 1c presents the overall KAP level as moderate and the mean score of KAP of AKI was 61.4%. The respondent's level of knowledge on AKI was medium n=47 (62.7%), while 28 (37.3%) respondents scored low with an overall score of the knowledge domain of 53.6%. Practice towards AKI risk assessment was measured where 58 (72.0%) respondents scored low on domain practice while their attitude toward AKI was high since 54 (72.0%) respondents scored high with a score of 43.3% overall. The percentage of attitude score towards AKI was 80.7% as shown in figure 1c. The findings suggested that KAP levels among nurses towards AKI which could benefit the patients care moderately.

Table II illustrates the distribution of KAP scores among current workers in the surgery department who had received advanced clinical training, education level and total years of nursing experience. From Table II, it was shown that respondents working in the Urology ward scored the highest (65.7%) among other units, while ophthalmology unit respondents had the lowest score

Table I: Characteristics of nurses

	N=75	%	Mean (SD)
Age			**35.7 (5.30)**
21-25	3	4.0%	
26-30	7	9.3%	
31-35	30	40.0%	
36-40	19	25.3%	
>41	16	21.3%	
Gender			
Female	72	96.0%	
Male	3	4.0%	
Education Level			
Diploma	62	82.7%	
Degree	13	17.3%	
Advance clinical training (Post basic)			
YES	33	44.0%	
NO	42	56.0%	
Nursing position			
Head nurse	9	12.0%	
Staff nurse	66	88.0%	
Total nursing experience			**9.78 (5.57)**
1-5 years	9	12.0%	
6-10 years	19	25.3%	
11-15 years	26	34.7%	
16-20 years	15	20.0%	
>21 years	6	8.0%	
Working experience in medical unit			
YES	16	21.3%	
NO	59	78.7%	
Working experience in medical unit (years)			
0 years	59	78.7%	
< 5 years	11	14.7%	
>5 years	5	6.7%	
Working experience in critical care unit			
YES	22	29.3%	
NO	53	70.7%	
Working experience in critical care unit (years)			
0 years	51	68.0%	
< 5 years	14	18.7%	
>5 years	10	13.3%	

(54.6%) on KAP of AKI. Respondents who had their advanced clinical training scored high marks (63.8%) compared to nurses who did not receive advanced clinical training (59.7%). Advanced training in coronary care displayed the highest score (73.7%) among the other types of advanced training. Apart from that, degree-holder respondents scored higher marks (64.1%) while diploma-holder respondents scored 60.6%. The respondents with more than 21 years of nursing experience scored the highest scores on KAP of AKI with a mean score of 64.0%.

Table III indicates the description of Domain 1 in Section B related to knowledge in assessing the respondent's

Table II: Distribution of KAP score

	N (%)	Score KAP		
		Mean (SD)	Min.	Max.
Current Working Unit				
Cardiothoracic Intensive Care unit (CICU)	6 (8.0%)	65.5 (9.28)	57.4	77.6
High Dependency Unit (HDS)	6 (8.0%)	58.6 (9.65)	49.4	73.8
Surgery 1 (Male General Surgery ward)	11 (14.7%)	59.2 (6.98)	58.4	68.0
Surgery 2 (Female General Surgery ward)	10 (13.3%)	63.0 (5.41)	54.4	69.2
Surgery 3 (Urology ward)	8 (10.7%)	65.7 (7.71)	56.2	75.6
Surgery 4 (Neurosurgery ward)	9 (12.7%)	59.0 (7.50)	49.8	70.4
Surgery 5 (Ophthalmology ward)	6 (8.0%)	54.6 (4.81)	49.4	61.4
Surgery 7 (Cardiothoracic ward)	6 (8.0%)	65.1 (4.65)	59.4	70.0
Surgery 8 (Plastic/maxillofacial/ENT)	7 (9.3%)	57.2 (8.38)	45.4	65.6
Burn Unit	6 (8.0%)	63.0 (12.4)	43.8	78.2
Advance clinical training (Post basic)				
NO	42 (56.0%)	59.7 (7.76)	43.8	78.2
YES	33 (44.0%)	63.8 (8.71)	47.4	77.6
ICU	8 (10.7%)	65.2 (10.7)	49.4	77.6
Coronary Care	2 (2.7%)	73.7 (5.23)	70.0	77.4
Renal	6 (8.0%)	68.1 (5.63)	58.0	74.4
Ophthalmology	5 (6.7%)	53.6 (4.70)	49.4	61.4
Neurology	3 (4.0%)	63.8 (5.80)	58.0	69.6
Rehabilitation	1 (1.3%)	69.2	69.2	69.2
Diabetic Educator	5 (6.7)	62.4 (5.77)	54.4	69.6
ENT	3 (4.0%)	58.7 (9.81)	47.4	64.4
Education Level				
Diploma	62 (82.7%)	60.6 (8.43)	43.8	78.2
Degree	13 (17.3)	64.1 (7.64)	52.0	77.6
Total nursing experience				
1-5 years	8 (10.7%)	61.9 (8.94)	45.4	73.0
6-10 years	20 (26.6%)	58.4 (5.67)	48.4	69.0
11-15 years	26 (34.7%)	61.9 (9.33)	43.8	78.2
16-20 years	15 (20.0%)	63.3 (8.91)	47.4	77.4
>21 years	6 (8.0%)	64.0 (9.09)	52.0	77.6

KAP- Knowledge, Attitude, and Practice, ENT- Ear, Nose, and Throat

Table III: Practice toward AKI risk assessment score

Question no.	Questions	Frequency of selection answers n (%)	Mean score ± SD	Full marks
			17.5 ± 3.64	**30**
C16	Overall knowledge on AKI risk assessment	Poor 20 (26.7%) Ordinary 30 (40.0%) Good 21 (28.0%) Very Good 4 (5.3%) Excellent 4 (5.3%)		
C17	Practice performs thorough AKI assessment	Not necessary 13 (17.3%) Occasionally 37 (49.3%) Always 13 (17.3%) Most 10 (13.3%) All the time 2 (2.7%)		
C18	Barrier when performing AKI risk assessment	Language barrier 8 (10.7%) Lack of time 5 (6.7%) Lack of knowledge 53 (70.7%) Lack of standardized protocol 8 (10.7%) Others 1 (1.3%)		
C19	In your opinion, all hospitalization patient at risk of AKI	YES 36 (48.0%) NO 39 (52.7%)		
C20	Emergency surgery is at risk of AKI	YES 38 (50.7%) NO 37 (49.3%)		
C21	The risk factors of AKI	Select correct risk factors 2 (2.6%) Select correct minimum factors 35 (46.7%) Select wrong factors 38 (50.7%)		
C22	Educating patients/ family regarding risk of AKI	Select maximum answers 2 9 (38.7%) Select minimum answers 46 (61.3%)		

AKI- Acute Kidney Injury

knowledge of AKI consisting of 15 questions that contribute to 30% of full marks. Each question in Section B contributes to 1 to 3 marks relatively and respondents who answered incorrectly received zero marks. Questions B1, B2A and B2B demonstrate a previous AKI education received from the respondents. Respondents would get 2 marks if they had received AKI education previously and they would have extra marks if they selected formal and informal modes of AKI education received.

The respondents who did not previously receive AKI education and chose NO for the B1 question received zero marks as well as questions B2A and B2B. The table showed that 72.0% (n=54) of the respondents received previous education on AKI throughout his/ her

working duration. 68.0% (n=51) and 50.7% (n=63) of the respondents received formal and informal modes of AKI education. For question B3, it was related to respondents' rating of current knowledge of AKI; 26.7% (n= 20) rated it as poor while 73.3% (n=55) rated it as average. Only 6.7% (n=5) respondents succeeded in defining the correct definition of AKI on the B4 question and 13.3% (n=10) respondents selected NO on the B9 question regarding rapid increase in serum creatinine of 25% from baseline value as a development sign of AKI. The majority of respondents answered correctly on Question B11 related to whether or not the increment of serum creatinine could have an impact on a patient's morbidity and mortality, as well as Question B12, which was about choosing the correct agents (medications) that cause AKI. Other than that, most of the respondents agreed on Question B13; patients who had a history of radio-contrast agents during diagnostic procedures will cause AKI and 84.0% (n=63) of respondents understood that haemodialysis is not the only option in treating AKI patients.

Domain 2 in Section C consisted of 7 questions on practice to determine nurses' practice in identifying AKI through risk assessment. The total number of marks in this section was 30 and the mean score of the respondents in domain practice was 17.5. Question C16 indicated that 26.7% (n=20) of respondents had knowledge of performing AKI risk assessments. Half of the respondents (n=37) occasionally performed thorough AKI assessments for all patients under their care in routine work. The majority (70.7%) did not perform an AKI risk assessment due to a lack of knowledge since almost half of the respondents were unsure about the risk factors of AKI.

Domain 3 in Section D stipulated the attitude towards AKI as shown in Table IV. The mean score of the respondents in this section was 31.3 out of 40 marks. More than half of the respondents agreed on statements every patient admission requires urine output, the importance of recording fluids, AKI will require a prolonged stay in the ward, AKI complications can be prevented through risk assessment if the patient is presented with signs and symptoms of AKI, the physician, patient/ family member needs to be taught on AKI risk factors and respondents are comfortable in detecting AKI during working hours. However, 56.0% of the respondents were unsure of whether or not their AKI knowledge is sufficient.

The correlation coefficient r= 0.397 and 0.315 indicated a positive relationship. In addition, there was an association between nurses' knowledge and practice on AKI risk assessment ($p < 0.01$). In addition, there was also an association between the nurses' practice on AKI risk assessment with attitude ($p< 0.01$). However, no significant relationship was observed between nurses' attitudes and knowledge of AKI scores in this study as presented in Table V.

Table IV: Attitude on AKI score

Question no.	Questions	Frequency of selection scale n (%)	Mean score ± SD	Full marks
			32.3 ± 5.02	**40**
D23	Every patient admission needs to measure urine output	Strongly agree 30 (40.0%) Agree 15 (20.0%) Neutral 15 (20.0%) Disagree 14 (18.7%) Strongly disagree 1 (1.3%)		
D24	Importance of recording fluids	Strongly agree 51 (68.0%) Agree 15 (20.0%) Neutral 8 (10.7%) Disagree 1 (1.3%)		
D25	AKI prolonged stay in the ward	Strongly agree 35 (46.7%) Agree 21 (28.0%) Neutral 11 (14.7%) Disagree 21 (28.0%) Strongly disagree 3 (4.0%)		
D26	Assessing AKI risk could prevent patient complication	Strongly agree 32 (42.7%) Agree 24 (32.0%) Neutral 16 (21.3%) Disagree 3 (4.0%)		
D27	Patient is at risk of AKI; therefore, I must notify physician	Strongly agree 40 (53.3%) Agree 19 (25.3%) Neutral 11 (14.7%) Disagree 4 (5.3%) Strongly disagree 1 (1.3%)		
D28	Patient/ family members need to be taught on AKI risk	Strongly agree 35 (46.7%) Agree 27 (36.0%) Neutral 11 (14.7%) Disagree 2 (2.7%)		
D29	I feel comfortable with the detection of AKI within my working hours	Strongly agree 21 (28.0%) Agree 34 (45.3%) Neutral 16 (21.3%) Disagree 2 (2.7%) Strongly disagree 2 (2.7%)		
D30	I feel confident, my AKI knowledge is sufficient	Strongly agree 13 (17.3%) Agree 13 (17.3%) Neutral 42 (56.0%) Disagree 5 (6.7%) Strongly disagree 2 (2.7%)		

AKI- Acute Kidney Injury

Table VI represents the differences between nurses' characteristics and total KAP on AKI score. A significant difference in KAP on AKI score was noted between ten working units in a surgical department (p=0.031). Nurses who had advanced training were found to have a significant difference in KAP on AKI score (p=0.019). Nurses such as head nurses and staff nurses were reported to have significant total KAP on AKI scores.
Table 8 indicates comparison of knowledge/attitude/ practice regarding AKI among nurses. The studies were conducted from year 2015 to 2018 involving single and multiple centre of public and private hospital. These studies mainly focused on assessing nurses' KAP related to AKI in different countries and healthcare settings. The objectives of the studies were mainly based on understanding the level of AKI-related awareness among nurses and the implications of their knowledge gaps. Most of the studies were measuring the nurses' knowledge level pertaining to the AKI, however a study in Brazil (2017) was measuring combinations of knowledge of AKI, risk factors, nurses attitude and practice inclusive of self-care measures towards patients (19). A study in Pakistan (18) using a modified version of the Adejumo (2017). Overall, the level of nurses'

Table V: Statistical differences between nurses' characteristics and KAP on AKI score

	KAP on AKI score		
	N (%)	Mean (SD)	*p*-value
Current Working Unit			
Cardiothoracic Intensive Care unit (CICU)	6 (8.0%)	65.5 (9.28)	0.031
High Dependency Unit (HDS)	6 (8.0%)	58.6 (9.65)	
Surgery 1 (Male General Surgery ward)	11 (14.7%)	59.2 (6.98)	
Surgery 2 (Female General Surgery ward)	10 (13.3%)	63.0 (5.41)	
Surgery 3 (Urology ward)	8 (10.7%)	65.7 (7.71)	
Surgery 4 (Neurosurgery ward)	9 (12.7%)	59.0 (7.50)	
Surgery 5 (Ophthalmology ward)	6 (8.0%)	54.6 (4.81)	
Surgery 7 (Cardiothoracic ward)	6 (8.0%)	65.1 (4.65)	
Surgery 8 (Plastic/maxillofacial/ENT)	7 (9.3%)	57.2 (8.38)	
Burn Unit	6 (8.0%)	63.0 (12.4)	
Advance clinical training (Post basic)			
NO	42 (56.0%)	59.7 (7.76)	0.019
YES	33 (44.0%)	63.8 (8.71)	
ICU	8 (10.7%)	65.2 (10.7)	
Coronary Care	2 (2.7%)	73.7 (5.23)	
Renal	6 (8.0%)	68.1 (5.63)	
Ophthalmology	5 (6.7%)	53.6 (4.70)	
Neurology	3 (4.0%)	63.8 (5.80)	
Rehabilitation	1 (1.3%)	69.2	
Diabetic Educator	5 (6.7)	62.4 (5.77)	
ENT	3 (4.0%)	58.7 (9.81)	
Nurse Position			
Head nurse	9 (12.0%)	66.9 (6.35)	0.032
Staff nurse	66 (88.0%)	60.6 (8.33)	

KAP- Knowledge, Attitude, and Practice, AKI- Acute Kidney Injury, ENT- Ear, Nose and Throat

knowledge pertaining AKI at moderate level generally. All studies are cross-sectional quantitative studies that aim to evaluate the KAP of nurses regarding AKI. Most of the studies involved nurses from various healthcare settings, including hospitals and primary care, and assess their understanding of AKI risk factors, definitions, clinical manifestations, and management (10,18.19,20). However, evaluating the KAP and understanding towards AKI the studies vary in the number of participants (sample size), ranging from 57 to 216 nurses. They were conducted in different countries: Nigeria (10), Brazil (19), Pakistan (10), and current research in Malaysia and at different times (2015-2022), reflecting diverse healthcare contexts and potential variations in AKI awareness among nurses in different regions. The studies include different categories of questions related to AKI knowledge (e.g., urine output, serum creatinine, risk factors), attitudes (e.g., informing patients, practicing healthy diets), and practices (e.g., performing urine tests, monitoring creatinine levels). The findings from each study reveal varying levels of AKI-related KAP among nurses, ranging from low to high, emphasizing the need for targeted education and interventions to improve AKI care.

In this study, it can be observed that, surgical nurses identified noteworthy deficiencies in their KAP that have important implications for patient care and outcomes. These deficiencies include a lack of accurate AKI definition (93.3%), limited understanding of AKI risk assessment (70.7%), and unfamiliarity with AKI risk factors (only 2.6% selected correct risk factors). These gaps highlight the potential for delayed recognition, inappropriate interventions, and missed opportunities to prevent AKI-related complications.

DISCUSSION

This study demonstrated that the knowledge level of surgical nurses on AKI risk assessment is dependable on education level, underwent advanced clinical training, years of total nursing experience and type of working unit in the surgical department. It was observed that a higher education level and years of nursing experience demonstrated a better understanding of knowledge, attitude and practice towards AKI risk assessment. Nurses who had advanced clinical training such as intensive care, coronary care, renal, ophthalmology, neurology, rehabilitation, diabetic education and ENT displayed higher knowledge, attitude and practice regarding AKI risk assessment compared to non-advance clinical training.

Nursing specialisation enables the development of advanced practice knowledge and skills that contribute to working autonomously in advanced and extended clinical practice roles in hospital and community settings. Additionally, Hamric et al. (21) stated that nurses who had advanced training in clinical roles were significantly more comprehensive in clinical knowledge and practice. Moreover, it serves a vital integral purpose in influencing and encouraging the team's integration while affecting the team's overall work quality (22). Interestingly, nurses working in the urology surgery ward are among those with the highest score in the KAP level of AKI risk assessment. This was mainly because of the naturality of the patients' disease that requires uro-nephro surgery such as prostatectomy, partial or radical nephrectomy, percutaneous nephrolithotomy, as well

Table VI: Comparison of knowledge/ attitude/ practice with other studies

Country of study/ year	N (Nurses)	Setting	Result	Total Questions	Question Category	
Nigeria, 2016	156	Multiple- 2 government hospital	Low (29.5%) Moderate (62.8%) High (7.7%)	28	K	Urine output reduced/normal in AKI
					K	Serum creatinine normal in AKI
					K	AKI risk factors
					K	Nephrotoxin medications
					K	Types of AKI
					K	Criteria AKI definition & staging
Brazil, 2015	216	Multiple- 6 hospitals	Knowledge on AKI not adequate	10	K	Situation categorized AKI
					K	Clinical manifestation of AKI
					K	AKI incidence rate in ICU
					K	AKI mortality in ICU
					K	Serum creatinine impact to mortality
					K	Ferosemide recommend for AKI
Pakistan, 2018	200	Multiple- 11 hospitals	Low (19.0%) Moderate (78.5%) High (2.5%)	51	K	Urine output reduced/normal in AKI
					K	Serum creatinine normal in AKI
					K	AKI risk factors
					K	Nephrotoxin medications
					K	Types of AKI
					K	Criteria AKI definition & staging
					K	AKI definition
					K	Serum creatinine level to inform nephrologist
					K	Kidney injury biomarkers
Brazil, 2017	57	Single- primary health care	Below average (< 50 points)	30	K	AKI risk factors
					P	Healthy diet
					P	Collect urine 24hours and perform check
					A	Inform patient on probable diagnosis
					A	Perform creatinine and albumin monitoring

K=knowledge, A= attitude, P= Practise

as other major and minor surgeries that are frequently performed, and the high risk of AKI after surgery. According to Rajan et al. (23), partial nephrectomy associated with postoperative AKI involves modifiable factors including baseline renal function, preoperative hypertension, longer duration of surgical time and ischemia time, as well as warm ischemia. In terms of managing post-operative nephrectomy patients, nurses should closely monitor patients' urine output, fluid intake, and renal profile results so that they are aware of AKI development among urology patients.

Relatively, the knowledge level of AKI among surgical nurses in HCTM was low to moderate level. This is similar to the findings in Nigeria (10) which showed nurses in government hospitals with 62.8% fair knowledge and 29.5% with poor knowledge of AKI. Insufficient knowledge of AKI has also been found among non-specialist trainee medical healthcare workers in the United Kingdom (24) and many studies recommended in-service training, educational program and workshops as among pedagogical strategies to enhance nurses and other healthcare workers' knowledge and better care delivery to patients (10, 11, 19). However, all the stated studies utilised different research tools to measure knowledge of AKI among nurses.

About 61.4% of the nurses knew that elderly patients were at a high risk of AKI, which contradicted Adejumo et al.'s study (8). Nevertheless, more than 90.0% of the nurses in this study were unable to correctly define the criteria of AKI and there were unsure about the rapid increase in serum creatinine as a significant development of AKI. Meanwhile in Pakistan, nurses were found to have moderate knowledge on AKI as report revealed knowledge pertaining nephrotoxin agents can cause AKI (18) but nurses in this study found to have good knowledge on medications causing AKI. Eventually, the knowledge gap was found in the definition of AKI and the risk factor, which is consistent with that of other studies (10,13,18,19,20).

In this study, nursing positions like head nurses had a better level of AKI knowledge as they had longer nursing experience with most of them having advanced clinical training. Thus, it is suggested that to get promoted to head nurse, there should be certain qualifications such as obtaining a degree or master's, advanced clinical

training and nursing experience of more than 5 years. For example, a retrospective study in Japan measured ICU patient outcomes by having a Certified Nurse Specialist (CNS) as the ICU head nurse. The study revealed that having a CNS as a head nurse in the ICU may help improve patient outcomes by leveraging these practical skills in nursing management (25). The International Council of Nurses describes nurse practitioner/ advanced practice nurses as experts in the knowledge base, holding a master's degree, as well as having the capability in complex decision-making skills and clinical competencies necessary for expanded practice (26). Even though there are no specific roles and designations of CNS in Malaysia, the roles and responsibilities can be expanded, adapted and recognised by improving management's roles and patients' clinical outcomes.

Furthermore, in regard to improving knowledge and skills, managers must actively encourage nurses in the surgical department to seek opportunities to advance their expertise while performing their duties. Encouragement like sending the nurses to formal education sessions like lectures, workshops and symposiums seems to help improve nurses' skills and knowledge. From this study, it was observed that nurses who had previous formal education on AKI resulting better KAP compared to nurses who did not undergo formal AKI education. Studies reported that about 61.0% of nurses in Malawi and 63.2% of nurses in Brazil who received previous formal knowledge of AKI during their specialisation course or advanced practice have good knowledge and nursing care practice on AKI compared to those with medium or low knowledge. This study also showed that receiving formal education on AKI provides better knowledge and practice in delivering care to patients. Therefore, knowledge of AKI is essential as a part of in-service training to enhance the detection and early recognition for better patient outcomes and management.

The findings indicating that nurses' KAP towards AKI are at a low to moderate level have significant implications for patient care and outcomes. Among the potential implications and the importance of addressing these deficiencies in knowledge would be impacted on patient care and outcomes. Addressing these deficiencies is of utmost importance as nurses are integral to the healthcare team and play a critical role in various aspects of patient care. This includes early detection, prevention, and management of conditions like AKI. When nurses lack the necessary knowledge, attitude, and skills related to AKI, it can result in a series of negative consequences that directly affect patient care and outcomes (10, 11,12) When AKI is not promptly and effectively managed, it can lead to a range of serious complications such as electrolyte imbalance whereby the kidneys play a vital role in regulating electrolyte levels in the body, such as sodium, potassium, and calcium (27). Unmanaged AKI can disrupt this balance, leading to potentially life-threatening imbalances that affect various bodily functions, including heart rhythm and nerve signalling. Hence, nurses with adequate knowledge AKI complications can take proactive measures to prevent these outcomes by ensuring adequate and normal range of electrolytes in order to prevent adverse effects such as hyperkalemia or metabolic acidosis leading to deterioration of patient's conditions.

Early detection of AKI is crucial for timely intervention, as it allows healthcare professionals to implement strategies that can halt or mitigate the progression of the condition. Nurses who possess a strong understanding of AKI can identify subtle changes in a patient's condition and promptly alert the medical team, enabling swift intervention and preventing complications. For example, high understanding on AKI progression, sign and symptoms as well as its complications enhancing nurses' recognition with appropriate risk factors assessment could avoid the unacceptable delay or unwanted death among post-admission surgical patients.

The identified deficiencies in KAP of AKI among surgical nurses have far-reaching implications that extend to patient outcomes and overall hospital quality of care. This underscores the critical need for addressing these issues through targeted educational programs. This study highlights the vital importance of addressing shortcomings in AKI risk assessment and patient care among surgical nurses within the healthcare field. The deficiencies in the KAP regarding AKI among these nurses could negatively affect patient outcomes. Nurses play a central role in patient care, spanning early detection, intervention, and ongoing monitoring. A lack of proper understanding about AKI risk assessment and management might lead to delays in recognizing the issue, incorrect interventions, and missed chances for timely care. This could result in patients enduring longer hospital stays, increased illness, and even avoidable death due to AKI-related complications. By equipping nurses with the requisite knowledge and skills, healthcare institutions can enhance patient safety, elevate hospital quality of care, and ultimately contribute to improved outcomes and well-being for patients. In the detection of AKI, this study refers to KDIGO staging system, with stage 3 AKI indicating the most severe decline in kidney function. Based on the results, this study emphasizes the urgency of early detection and effective management and the need for vigilant monitoring and timely intervention to improve patient outcomes in Malaysian healthcare settings.

CONCLUSION

In conclusion, there were significant deficiencies such as lack of accurate AKI definition, limited understanding of AKI risk assessment, and unfamiliarity with AKI risk factors in the KAP of AKI among surgical nurses in a single-centre setting in Kuala Lumpur, Malaysia. These

deficiencies of understanding AKI resulted to moderate level of KAP pertaining to AKI leads to moderate quality of care towards patients in surgical units. The deficiencies in KAP regarding AKI among surgical nurses have the potential to adversely impact patient outcomes. Nurses play a central role in patient care, from early detection, continuous monitoring to intervention in delivery of care to patients. Hence, these issues need to be highlighted in continuously educating nursesthrough education programs such as continuous nursing education, lectures and seminars on AKI, with more emphasis on surgical nurses.

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