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ORIGINAL RESEARCH

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Development of a patient classification system for critical care nursing based on nursing intensity

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Abstract

Aim: This study aimed to develop a valid and reliable new intensive care unit nursing classification tool, including direct and indirect nursing activities, by measuring the nursing intensity provided to patients.

Background: Prior tools primarily examine patients' medical records or disease severity/interactions, systematically failing to reflect comorbidity risk factors.

Design: The Delphi technique was used to test the content validity of the Korean Patient Classification System on Nursing Intensity for Critical Care Nurses (KPCSNIC).

Methods: Data were collected from four hospitals in two provinces from 26 December 2017 to 30 January 2018. To verify construct validity, staff nurses classified 365 patients, comparing differences by medical department and type of stay. To verify interrater reliability, data collectors and the head nurses of three intensive care units classified 87 patients.

Results: The KPCSNIC had 8 categories, 44 nursing activities and 105 criteria. Reliability was high ($r = .84$). Construct validity was verified by revealing differences according to medical department and type of patient. Using total scores, four KPCSNIC groups were identified.

Conclusion: The KPCSNIC developed in this study can support staffing for nursing intensity by providing more specific evaluation criteria. Moreover, it reflects nursing intensity, including direct and indirect nursing activities.

KEYWORDS
classification, critical care, intensive care unit, Korea, nursing, patient identification systems

Summary statement

What is already known about this topic?

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- In order to secure the quality of nursing care, it is important to allocate an appropriate number of nurse staffing based on nursing demand and nursing time reflecting to the number and severity of patients, and shift of work.
- The patient acuity tools used in Korea are limited as they primarily examine patients' physiological characteristics based on medical records or quantify disease severity and interactions, systematically failing to reflect risk factors for comorbidities.
- The intensive care unit patient classification tool that is currently used underestimates clinical nursing intensity, as it does not realistically evaluate patient-related disease factors and indirect nursing activities.

What this paper adds?

- This study developed a new patient classification tool that reflects patients' clinical characteristics and classified them according to nursing intensity.
- In addition to direct nursing activities, indirect nursing activities that were invisible and difficult to measure can be scored using this tool.

The implications of this paper:

- Since this tool enables quantitative measurement of nursing workload, data using this tool can be used as evidence for invoicing for nursing care fees, previously calculated as a percentage of inpatient fees per day.
- This study was conducted in a first-grade hospital with a high level of nurse staffing. To secure the validity and reliability of the tool, additional research is needed, using the tool in a greater number and wider range of hospitals.

1 | INTRODUCTION

To provide quality care that is clinically adequate and meets patients' needs, nurse staffing should appropriately match the allocation of nursing hours to effectively address the varied nursing demands (i.e., patient load, condition severity and working hours) (Moon et al., 2007). Accurately identifying the nursing demands required in intensive care units (ICUs) to meet patients' needs would enable the appropriate allocation of nurses, implementation of severity-specific fee systems and implementation of ICU standards. Various tools have been used to predict the patient acuity for ICU admissions in Korea, including the Simplified Acute Physiology Score II, the mortality prediction model, the Therapeutic Intervention Scoring System, and the Acute Physiology, Age, and the Chronic Health Evaluation III (APACHE III) (Kim & Kim, 2011; You et al., 2011). These indices focus only on patients' physiological conditions based on medical records and/or disease severity and interactions and fail to consider risk factors such as comorbidities.

The Nursing Activities Score (NAS) is a classification system of critical care nursing (CCN), which uses a combination of the amount and the level of nursing care activity. Comprising 23 sub-items (Miranda et al., 2003; Padilha et al., 2015), NAS tools have been used in various countries; however, their theoretical basis has not been validated (Reis Miranda & Jegers, 2012). Furthermore, NAS's content validity was investigated using the Italian ICU Specialist Nurse Focus Group, and its face validity was confirmed by translation by 10 experts (Palese et al., 2016). NAS tools are not currently considered adequate to measure the ICU nursing activity and average time consumption. They show a lack of consistency, reliability and content validity. To overcome these limitations of existing tools, new patient classification tools for critical care units need to be developed to accurately measure direct and indirect nursing activities.

In Korea, patient classification systems are either developed by researchers (Yoo & Kim, 2013) or adapted from a modified version of an ICU classification tool (Cho et al., 2005)—modelled on the Workload Management System for Nurses, the Walter Reed Army Medical Center or the Korean Patient Classification System for Nurses (KPCS), developed by the Hospital Nurses Association. Studies in Korea have generally focused on validating tools based solely on direct nursing activities, while relatively neglecting indirect nursing activities. These patient classification tools may underestimate the nurse staffing demands and do not adequately account for disease-related factors and indirect nursing activities. As nursing needs can vary, it is vital to examine disease-related factors and classify direct and indirect nursing activities when investigating nursing intensity.

Although the APACHE III is widely used as a tool for admission criteria in ICUs, it requires the results of haemodynamic tests, which may not be performed during an ICU admission, making it time consuming and costly (Seong, 2013). The KPCS does not accurately

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reflect medical severity and hinders efficient nursing performance owing to differences in patient classification based on medical severity and nursing intensity. Thus, a new patient classification tool, which reflects patients' clinical characteristics and nursing intensity, is required.

2 | METHODS

2.1 | Aim

This study developed a patient classification system—the Korean Patient Classification System on Nursing Intensity for Critical Care Nurses (KPCSNIC)—for critical care units based on the required level of nursing intensity and verified this system's reliability and validity. The COnsensus-based Standards for the selection of health Measurement Instruments (COSMIN) initiative aimed to improve the selection of health measurement instruments (Mokkink et al., 2010) and was used to guide this study.

2.2 | Design

This methodological instrument development study employed the Delphi technique to test the content validity of the KPCSNIC in four hospitals across two locations.

2.3 | Tool development

The basic components of the KPCSNIC were identified by reviewing relevant literature from May to September 2017. A literature search was conducted on Korean databases—RISS4U and the National Assembly Library—using the following key terms: 'severity', 'patient classification' and 'ICU'; and international databases including Medline and CINAHL using the following keywords: 'patient classification' and 'severity'. Next, a draft was developed including the items needed to assess nursing intensity and patient severity. It was developed by reviewing the nursing domains, nursing activities, items for each nursing activity and scores for each nursing activity used in the relevant literature on development of a critical care classification tool based on nursing needs (Cho et al., 2000, 2005; Ferreira et al., 2017; Kim & Jang, 2002; Lee et al., 2000; Lundgrén-Laine & Suominen, 2007; Padilha et al., 2008; Stafseth et al., 2018; Sung et al., 2007) and measurement of nursing hours (Cho et al., 2000, 2005; Kim & Jang, 2002; Sung et al., 2007). Lastly, the draft was reviewed and modified after consultations with six clinical experts (one researcher and five nurses with master's degrees and at least 3 years of clinical experience) from 27 September to 12 October 2017. As a result, the tool comprised a three-tier hierarchy—domains, subdomains and nursing activities—and definitions of nursing activities and scoring criteria were established (Mokkink et al., 2010).

2.4 | Content validity of the first revision

2.4.1 | Expert panel and Delphi technique

An expert panel to establish the content validity using the Delphi technique should comprise 3–10 experts (Lynn, 1986); therefore, five nursing unit managers (with five or more years of clinical experience) and nine head nurses ($N = 14$) were recruited. The criteria for selecting experts were those with ICU nursing experience, nurses with >5 years of clinical experience working at a general hospital and holders of master's degree.

2.4.2 | Content validity testing

The first round for the Delphi survey was conducted from 13 to 30 October 2017. The experts received information via email specifying the quality of each proposed content item according to domains, nursing activities and nursing activity standards for the patient classification tool. Experts scored each item on a 4-point scale and suggested an alternative for items with low scores.

Next, the second round of the Delphi survey was conducted from 6 to 16 November 2017. They received item mean scores from the first round along with the first-round scores for each item. Experts rated the content validity for each item using a 4-point scale (4 = *very valid* to 1 = *not valid at all*). For items with a score of 1 or 2, they suggested an alternative in accordance with the study's direction. The content validity index (CVI) for each item was computed, and items with over 80% agreement were selected as significant. The experts rated the appropriateness of each item on a 4-point scale, including their opinion about revisions. In this round, all items were rated to be acceptable, and the second revision was finalized. The survey items by hospital, which could assess severity by nursing unit, were finalized as follows.

2.5 | Construct and concurrent validity (clinical validity) of the second revision

To test the clinical validity of the second revision, four hospitals (tertiary hospital/general hospital/local clinic) in two provinces were convenience sampled from 26 December 2017 to 30 January 2018. Fourteen nurses working in medical and surgical ICUs were convenience sampled from each hospital. Each nurse applied the finalized patient classification tool for 365 patients. One data collector in each ICU was trained on the data collection method. Finally, the nurses performed patient classification on the survey day. An information session was held in the four hospitals for the nurses and nurse unit managers involved in the patient classification to elaborate on the study rationale and methods. Each nurse applied the second revision to 30 patients.

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Additionally, clinical information for patients, including sex, age, disease (including primary diagnosis and comorbidities), length of stay, body weight, hospital entry route, surgery and use of ventilator, was collected during the KPCSNIC assessment. Concurrent validity was tested by comparing the results with those of the present patient classification tool used by the hospital at the time of the investigation, applied to the same patients.

2.6 | Interrater reliability of the second revision

The ICU head nurse was designated as the data collector. Two of four hospitals were selected (convenience sampled), and one nurse manager and one staff nurse were chosen from each of the three ICU nursing units. Thirty patients were selected from each ICU, and after excluding three questionnaires with incomplete responses, patient classification was performed with 87 patients to test interrater reliability, which was analysed based on the intra-correlation coefficients. To minimize deviations in patient transfer and severity according to the day of the week, data were collected on Tuesdays, Wednesdays or Thursdays. The same patients were classified in two periods to test interrater reliability based on the rating agreement between the two classification rounds.

2.7 | Instrumentation

2.7.1 | Draft patient classification tool

The KPCSNIC comprised seven items about general characteristics (including sex and age) and 14 items about disease-related factors. The draft KPCSNIC based on nursing intensity comprised 104 items for 49 nursing activities, 22 subdomains and 8 domains. For each item, the assessment criteria and score are included, and the sum of these scores represents the total score. The group classification was determined based on the total score.

The clinical characteristics including body weight, route of hospital entry, surgery, ventilator, extracorporeal membrane oxygenation (ECMO), continuous renal replacement therapy (CRRT) and treatment procedures were surveyed.

2.7.2 | Korean patient classification tool

The Korean patient classification tool comprises 12 items for 48 classification criteria. It was used to classify critical care patients in the 2007 Korean medical institution appraisal. This tool was used to test the concurrent validity of the KPCSNIC developed in this study.

2.8 | Study procedure

Figure 1 shows the study flow.

2.9 | Ethical considerations

Prior to this study, its objectives were explained to the director of the nursing department and cooperation was requested. Nurses who provided written informed consent were enrolled. Participants' confidentiality was ensured, and they could withdraw from the study at any point. The investigator distributed the questionnaires after explaining the study purpose and instructions concerning the questionnaire and consent form. This study was approved by the institutional review board at the affiliated university (WKIRB-201710-SB-076). Participants were informed that any data collected would only be used for research purposes, and there was no disadvantage regarding non-participation.

2.10 | Data analysis

The data collected were analysed with SPSS 23.0 software (IBM, Armonk, NY, USA). The specific analyses were as follows:

1. Participants' general characteristics were analysed by descriptive statistics, and the content validity of the KPCSNIC was analysed with CVI.
2. The interrater reliability of the KPCSNIC was tested using the intra-correlation coefficient.
3. The construct validity of the KPCSNIC was tested by analysing the differences between patient classification scores by clinical characteristics of patients using *t* tests and analyses of variance. Scheffé's test was used for post hoc analyses.

The COSMIN checklist is used to evaluate the methodological quality of studies. The KPCSNIC development process was based on a modified version of the COSMIN guideline for selecting outcome measurement instruments for outcomes included in a core outcome set (Mokkink et al., 2010).

3 | RESULTS

3.1 | Development of the draft KPCSNIC

The following eight nursing domains were selected in draft development: symptom management, infection management, nutrition and medication administration, personal hygiene and secretion, activity/sleep and rest, nursing guidance/emotional support, indirect activities, and nursing activity plans and adjustment. Minimum frequency was determined by the day or work shift for each nursing activity. After two rounds of content validity testing, 58 nursing activities across eight domains were selected (e.g., symptom management [monitoring, respiration, circulation and wound care] and infection management [isolation and catheter management]). In the second round of testing, the CVI was 0.94, and 104 items for 58 nursing activities across eight domains were finalized (Tables 1 and 2).

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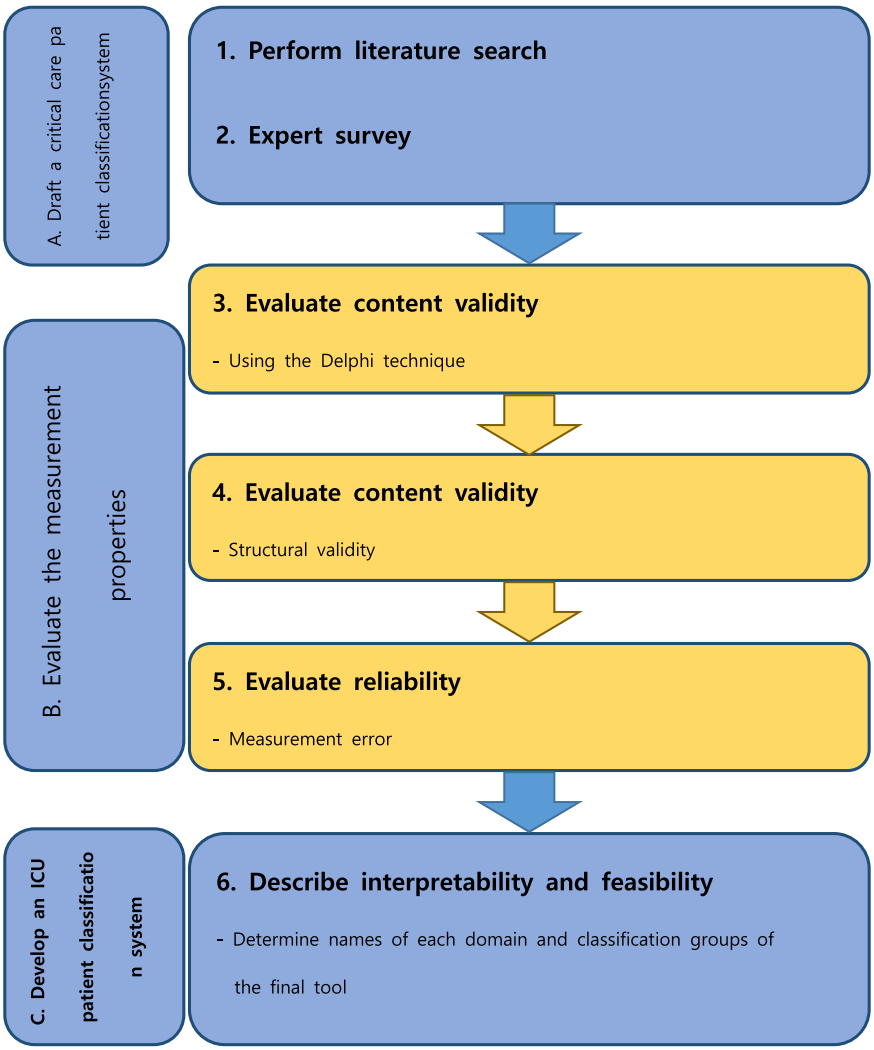


FIGURE 1 Six steps for conducting research. ICU, intensive care unit

3.2 | General characteristics

The demographics of the 365 patients were analysed and are shown in Table 3.

After excluding the disease factors, the minimum and maximum scores for 365 patients were 21 and 114, respectively. When disease factors were added, the minimum and maximum scores were 23 and 122, respectively. The mean score was 53.36 ± 15.62, and 69.9% of the patients scored between 31 and 60 (Table 4). Patient-related and disease-related factors included body weight, route of hospital admission, surgery, ventilator, ECMO, CRRT and procedures. Each factor was scored on a 0–4 scale, and the sum of the scores was used.

3.3 | Interrater reliability testing

Interrater reliability was tested by analysing the data from a nursing manager and eight staff nurses from three ICUs with 87 patients. It was assessed using intra-correlation coefficients. The results showed that nursing intensity scores rated by nursing managers and staff nurses showed a high consensus (Table 5). Interrater reliability of the second revision was tested using single measure intraclass correlations. There was a high agreement in total classification score ($r = .84$; $p < .001$). By domain, agreement was the highest for the nursing intensity score for the 'symptom management' domain ($r = .87$; $p < .001$). Consensus for the 'personal hygiene and secretion' domain was low ($r = .72$; $p < .001$).

3.4 | Content validity testing

The nursing intensity scores were 41.61 for those admitted on a wheelchair or on foot, 52.05 for those admitted through the emergency department and 57.97 for those admitted from a general ward. The scores were significantly different among these three groups ($p < .001$). Furthermore, the nursing intensity scores significantly differed in line with nurses' subjective classification of patients, where the scores were higher for Groups 3 and 4 than for Groups 1 and 2 ($p < .001$; Table 6).

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TABLE 1 Disease-related factors among patient classification according to severity and nursing needs

Category		General ward classification factor	Check	Remarks or additional comments
Disease-related factor	Gender	Male		
		Female		
	Age	Age (years)	___years	
	Disease	Major disease (1st)		(For example, if the patient has a history of high blood pressure, heart disease and diabetes, make sure to describe)
		Comorbidity 1 (2nd)		
		Comorbidity 2 (3rd)		
		Comorbidity 3 (4th)		
	Length of stay (days)		___days	
	APACHE III	Score on entry	Score:	Fill in the appropriate
	SAPS	Score on entry	Score:	

Category	General ward classification factor	Weight	Check	Remarks or additional comments
Weight	<70 kg	1		
	70–89 kg	2		
	>89 kg	3		
BMI				
Entrance route	In wheelchair or on foot hospitalization (visit on foot in non-emergency situations)	1		
	Emergency room	2		
	General ward	3		
	Transfer from other hospital	2		
	Entering from operating room	3		Operation name:

Abbreviations: APACHE III, Acute Physiology, Age, and the Chronic Health Evaluation III; BMI, body mass index; SAPS, Simplified Acute Physiology Score.

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TABLE 2 Patient classification tool according to nursing needs (for intensive care unit)

OPC area	Subcategory	Nursing activity: Item	Operational definition	Standards	Score	Mark (V) in the appropriate box
1. Symptom management	Observation	Vital sign check	Check vital signs using NIBP	Device installation	1	
				When measuring continuously after installing the device ('CONTINUOUSLY' for NIBP)	2	
			Check vital signs through catheters such as A line	Continuous measurement after insertion	1	
				Preparation for A-line insertion	2	
	Respiration	Ventilator observation and blood gas inspection	In case of a patient with a ventilator, observe the ventilator and perform a blood test - Blood test (e.g., ABGA) - Ventilator observation (e.g., bagging, aspiration and intubation, ventilation, artificial airway nursing and aspiration)	3-4h interval	1	
				1-2h interval	2	
				Less than hour interval Main respiratory intervention takes more than an hour	3	
		Thoracic physiotherapy	Includes vibrator application performed by a nurse, excluding those implemented in the PT room	1–3 times/day	1	
				4–5 times/day	2	
				>5 times/day	3	
		Blood gas testing during high-flow oxygen therapy		3-4 h interval, frequent suction	1	
				2 h interval, frequent aspiration nursing	2	
	Circulation	Observation: Vital sign (check temperature, pulse and respiration rate, and blood pressure)		Check vital sign every 2 h	1	
				Check vital sign every 1 hour	2	
				Check vital sign <1 h	3	
		Cardiac output	Non-invasive CO monitoring while observing vital signs	Observation of cardiac output within 2 h	2	
			Invasive CO monitoring while observing vital signs	Emergency or surgical intervention Cardiac output observed within 2 h	3	
		Vasopressor use		No use	0	
				Use (add 1 point per number of medicine)	1	___number of medicines

(Continues)

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TABLE 2 (Continued)

OPC area	Subcategory	Nursing activity				
		Item	Operational definition	Standards	Score	Mark (V) in the appropriate box
		CPR or not		No	0	
				Yes	3	
		ECMO usage status		No	0	
				Yes	3	
		Massive infusion usage status	Including the loading of crystalloids	No use	0	
				Use	1	
		Infusion of colloidal solution usage status	For example, albumin	No use	0	
				Use	1	
		Number of IV fluid injections (this refers to the number of fluid injections, not the number of pumps)	① Inject >500 ml of fluid ② 100 ml + antibiotics are mixed and injected ③ 100 ml + electrolyte solution are mixed and injected Sum ①, ② and ③	<5 IV injections	1	
				IV injections 5–8	2	
				>8 IV injections	3	
	Wound care	Simple wound dressing	Including pressure area care and T-site care	<15 min	1	
				15-29min	2	
				>29 min	3	
	Isolation	Reverse isolation/contact isolation/splash and air isolation nursing		No isolation	0	
				Reverse isolation care	2	
				Contact isolation	3	
				Implanted patient isolation and nasal and air isolation	4	
2. Infection control	Catheter management	Inserting and maintaining catheters	Catheter maintenance (e.g., central venous catheter and chest tube) But except endo tube	1-3 catheters	1	
				>3 catheters	2	
			On the day of catheter insertion (e.g., monitoring back exchange work for monitoring kidney catheter, BP, CVP and ICP)	1-3 catheters	3	
				>3 catheters	4	
3. Nutrition and medication	Nutrition	Tube feeding	Single-bolus	1–3 times/day	1	
				4–6 times/day	2	
				7–12 times/day	3	
			Continuous	Machine use	2	
				No machine use	3	

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TABLE 2 (Continued)

OPC area	Subcategory	Nursing activity				
		Item	Operational definition	Standards	Score	Mark (V) in the appropriate box
		Adult meal assistance (spoon-feeding)		Rice 1–3 times/day	1	
				Soft diet 1–4 times/day	2	
				Soft diet >4 times/day	3	
	Medication	Intravenous infusion		**Keep IV route**	2	
			Excluding persistent infusion drugs	Number of intravenous one-time injections	times	
		Blood transfusion		WB and RBC	1	WB___pint RBC___pint
				P. Conc. and FFP	2	P. Conc. ___pint FFP___pint (P. Conc. measured in each case)
				Using blood warmer pumping machine WB and RBC	3	WB and RBC___ pint
			Massive blood transfusion use status	No	0	
				Yes	3	
		Non-mainstream medication	Daily survey and give 1 point for each count	IM, SC, ID, PO, SL, L tube and a drops solution	___times/day	
			For burn patients, this is the case when applying a drug	Ointment	1	___times/day
				Local burn	2	
				Whole-body burn	3	
4. Personal hygiene and excretion	Personal hygiene	Oral care/perineal care/bed bathing/clearing faeces	Includes oral care for endo-tube fixation in oral care	Oral care and perineal care	1	
				Oral care, perineal care and bed bathing	2	
				Oral care, perineal care, bed wash and bed bathing	3	
				Clearing faeces or urine and changing diaper	4	___times
	Excretion	Enema		No enema	0	
				General enema and surgical enema	1	
			For example, Duphalac and Kalimate enema	Therapeutic enema and drug enema	2	___times/day

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TABLE 2 (Continued)

OPC area	Subcategory	Nursing activity				
		Item	Operational definition	Standards	Score	Mark (V) in the appropriate box
		Intake and output, and dialysis	For example, chest tube and in-dwelling catheter. Each chest tube is counted as one	Of all kinds of drainage Record per hour	2	Number of drainage tubes
			Maintain CVVH, PD and CAVHD	Maintain and record of loss every 30 min	3	
			Start CVVH, PD and CAVHD	On the day of insertion, record loss every 30 min	4	
5. Activity, sleep and rest	Mobility	Change of body position	Number including nursing assistance	No need to change position but need mobility care	1	
				Need 1-2 nurses when changing body position	2	
				Need >2 nurses when changing the body position	3	
		Restraint	This refers to the case where the body position is changed even if the restraint system is not required	Do not need a restraint but need help to change the body position	1	
				Partial restraint required or two upper extremities	2	
				Whole-body restraint or two or more upper and lower extremities	3	
				Chest restraint	4	
6. Guidance and emotional support in nursing	Emotional support	Communication		Need some help in communicating	1	
			This also applies to conscious patients with ventilation	Significant time and effort required for communication	2	
			For example, cognitive impairment and loss of vision/audience/language skills Includes non-cooperative, aggressive, demanding and delirious patients	Takes a lot of time and effort to communicate	3	
	Guide etc.	Hospitalization, transfer etc.		Patient transfer	2	
			Various monitoring items such as fluids and equipment are included when moving into the examination room	Hospitalization, transfer and room movement	4	

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TABLE 2 (Continued)

OPC area	Subcategory	Nursing activity		Standards	Score	Mark (V) in the appropriate box
		Item	Operational definition			
		Visitor management	Include in case, in addition to the designated intensive care unit visit time, it is necessary to communicate about the patient's condition through telephone etc.	Need ordinary support and short phone descriptions by the bedside	1	
				Need to communicate with visitors even after leaving the bed	2	
		Family counselling		A visitor who discusses prognosis and death or is overly anxious	3	
7. Indirect activity	Cognitive work burden	Notify to doctor	Including face to face and telephone	1-3 times/shift	1	
				4-5 times/shift	2	
				>5 times/shift	3	
		Training and supervision of new nurses		Not applicable to the preceptor	0	
				Preceptor to a preceptee with two or more months of experience nurse	2	
				Preceptor to a new nurse preceptee (<2 months)	3	
		Student education		Training a student nurse	2	
	Response and delivery	Patient-related calls and transfers	For example, assistant call, supplies transfer and patient movement	1–3 times/shift	0	
				>3 times/shift	2	
		Multidisciplinary management	Call for consultation with other medical services	1-3 times/shift	0	
				>3 times/shift	2	
	Facility management	Equipment replacement	In case of patient-related medical equipment replacement For example, ventilator replacement and CRRT filter replacement	No	0	
				Yes	3	___times/shift
	Research	Intensive care unit study	Studies related to the patient		1	
8. Nursing activity planning and coordination	Nursing activity planning and coordination	Handover time	Handover time of individual patients	<10 min/shift	1	
				10–29 min/shift	2	
				>29 min/shift	3	
				1–2 times/shift	1	

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TABLE 2 (Continued)

OPC area	Subcategory	Nursing activity		Standards	Score	Mark (V) in the appropriate box
		Item	Operational definition			
		Number of times spent on the nurse assessment and nursing plan	Including preparation time for applying nursing process and taking over when taking three or more of GCS, P/S, L/R, muscle power and BIS monitoring	3–4 times/shift	2	
				5 times/shift	3	

Abbreviations: A line, arterial line; ABGA, arterial blood gas analysis; BIS, bispectral index; BP, blood pressure; CAVHD, continuous arteriovenous haemodiafiltration; CO, cardiac output; CPR, cardiopulmonary resuscitation; CRRT, continuous renal replacement therapy; CVP, central venous pressure; CVVH, continuous veno-venous haemofiltration; ECMO, extracorporeal membrane oxygenation; FFP, fresh frozen plasma; GCS, Glasgow Coma Scale; ICP, intracranial pressure; ID, intradermal; IM, intramuscular; IV, intravenous therapy; L/R, light reflex; NIBP, non-invasive blood pressure; OPC, Oulu Patient Classification; P. Conc., platelet concentrate; P/S, pupil size; PD, peritoneal dialysis; PO, per oral; PT, physical therapy; RBC, red blood cell; SC, subcutaneous; SL, sublingual; WB, whole blood.

3.5 | Determination of patient classification

Table 7 shows the results of a non-hierarchical cluster analysis with four patient classification groups. It also shows the critical care classification groups that were determined in this study with reference to the patient classification results found in the non-hierarchical cluster analysis (reflecting the range of the maximum value).

3.6 | Finalization of the nursing intensity survey tool

The nursing intensity assessment tool was finalized after establishing interrater reliability. The CCN intensity survey is distinguished from the existing patient classification tool in that it includes indirect nursing activities, enabling users to identify the actual nursing intensity. After verifying the content validity in clinical settings, deliberation about adding a student education item occurred, in addition to the new nurse activities, as a part of the indirect nursing activities. The research subdomain was moved from the nursing guidance/emotional support domain to the indirect nursing activities domain. After clinical validity testing, items under each nursing activity, originally defined as based on a 24-h day, were modified to be based on work shifts.

The KPCSNIC comprised eight domains:

1. Symptoms management including four subdomains (monitoring, respiration, circulation and wound care) and 14 nursing activities,
2. Infection management including two subdomains (isolation and catheter management) and three nursing activities,
3. Nutrition and medication administration including two subdomains and eight nursing activities,
4. Personal hygiene and secretion including two subdomains and five nursing activities,
5. Sleep and rest including one subdomain and two nursing activities,
6. Nursing guidance and emotional support including two subdomains and four nursing activities,
7. Indirect nursing activities including five subdomains (cognitive work burden, bedside education and supervision, coping and delivery, facility management, and nursing activity and coordination) and seven nursing activities, and
8. Nursing activity planning and coordination including one subdomain and two nursing activities.

Thus, the final tool comprised 44 nursing activities across 18 subdomains and 8 domains (Table 3)

4 | DISCUSSION

This study developed and assessed the validity and reliability of a simple critical care patient classification tool that included not only direct but also indirect nursing activities, which are difficult to measure but account for a considerable portion of nursing work. The draft

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TABLE 3 Patients' general characteristics ($N = 365$)

Variable	Category	*n* (%)	Mean ± SD
Sex	Female	175 (47.9)	
	Male	190 (52.1)	
Age (years)	20–59	65 (18.5)	72.17 ± 14.31
	60–79	159 (45.3)	
	≥80	127 (36.2)	
Body weight (kg)	<70	277 (76.7)	
	70–89	74 (20.5)	
	≥90	10 (2.8)	
Route of hospital admission	Wheelchair or on foot	26 (7.2)	
	Emergency department	210 (58.5)	
	General ward	123 (34.3)	
Surgery	No	194 (53.2)	
	Yes	81 (22.2)	
	Missing	90 (24.7)	
Use of ventilator	No	239 (65.5)	
	Yes	125 (34.2)	
	Missing	1 (0.3)	
Use of ECMO	No	364 (99.7)	
	Yes	1 (0.3)	
Use of CRRT	No	354 (96.4)	
	Yes	11 (3.0)	
Procedure	No	309 (84.6)	
	Yes	56 (15.3)	

Abbreviations: CRRT, continuous renal replacement therapy; ECMO, extracorporeal membrane oxygenation.

TABLE 4 Nursing intensity score ($N = 365$)

Patient classification score	Frequency (persons)	Percentage
1–30	15	4.1
31–60	255	69.9
61–90	87	23.8
91–122	8	2.2

KPCSNIC was developed by reviewing the existing literature and was tested for content validity by an expert group. Furthermore, construct validity was examined to confirm clinical relevance. The finalized KPCSNIC comprised 105 items across 44 nursing activities and 8 domains.

The interrater reliability was measured based on rating agreement, and the results indicated that the tool can be generally accepted. The reliability for the personal hygiene and secretion domain was low. This may be attributable to the fact that nurses, nursing assistants and caregivers are all involved in personal hygiene and the results may have differed depending on who was performing personal hygiene activities and who was recording the activity. In the future, nursing activities with low interrater reliability should be modified to help nurses understand them more clearly.

Nursing is a multilateral process that includes the dynamics of workflows that must be kept up to date with unique patient needs. As described in this study, the amount of time a nurse spends on a patient depends on the heterogeneity of the patient group in a specific nursing unit (Upenieks et al., 2007). Upenieks et al. (2007) suggested that nursing hours should include bedside care and the time spent cooperating with team members, reviewing charts, preparing for medication administration, undergoing education and training, and communicating with family members.

It is difficult to develop a patient classification tool that perfectly suits all nursing settings (Song et al., 2010). This study attempted to measure indirect nursing activities that were neglected in existing tools. The number of notifications that nurses report to physicians and stratified educational activities, such as training and supervising new nurses and educating students, was computed. Furthermore, activities such as patient-related calls, patient transfer, delivery of supplies, number of calls requesting for consultation in another specialty, replacement of facility equipment, ICU research, handover time for individual patients, and scores for nursing assessment and nursing plans were stratified. As suggested by Upenieks et al. (2007), value-adding activities were divided into direct and indirect care, and non-value-adding activities into personal, consumption and other activities. Essential activities were divided into recording, indirect nursing and

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Category	Staff nurse	Head nurse	r	p
Symptom management	12.99 ± 3.68	12.71 ± 3.88	.87	<.001
Infection management	4.17 ± 2.55	4.34 ± 2.40	.81	<.001
Administration in nutrition and medication	12.63 ± 8.34	13.37 ± 9.02	.85	<.001
Personal hygiene and secretion	11.21 ± 3.95	11.26 ± 3.80	.72	<.001
Activity/sleep and rest	5.05 ± 1.42	4.97 ± 1.38	.80	<.001
Nursing instruction and emotional support	5.16 ± 2.09	4.79 ± 1.98	.77	<.001
Indirect activities	5.44 ± 3.76	4.07 ± 3.03	.75	<.001
Nursing activity plans and adjustment	4.09 ± 1.64	4.55 ± 1.40	.81	<.001
Total	60.74 ± 17.96	60.07 ± 15.76	.84	<.001

TABLE 5 Interrater reliability for each category ($N = 87$)

TABLE 6 Nursing intensity score by patient-type group ($n = 361$)

Category		n (%)	Mean (SD)	F	p	Sheffe's test
Route of hospital admission	Wheelchair or on foot hospital admission[a]	26 (7.2)	41.61 (7.67)	14.666	<.001	a < b < c
	Emergency department[b]	210 (58.5)	52.05 (14.80)			
	General ward[c]	123 (34.3)	57.97 (16.29)			
Nurses' subjective perception for PC	Classes 1 and 2[d]	87 (21.1)	40.58 (7.87)	74.006	<.001	d < e < f
	Class 3[e]	140 (38.7)	52.42 (12.41)			
	Class 4[f]	134 (37.1)	62.58 (16.32)			
Surgery	No	194	53.61 (16.62)	−1.659	.098	
	Yes	81	57.22 (16.04)			
Use of a ventilator	No	239	49.18 (13.04)	−7.257	<.001	
	Yes	125	60.86 (17.15)			

Abbreviation: PC, patient classification.

Class[a]	n	Mean (SD)	Min	Max	PC score range	Revised PC score range
1	138	39.13 (5.82)	23	46	1–40	1–49
2	151	54.51 (4.58)	47	63	40–70	50–69
3	65	72.04 (6.48)	64	87	70–100	70–99
4	11	102.27 (10.91)	89	122	≥100	≥100

TABLE 7 Patient classification score by classification group in the non-hierarchical cluster analysis

Abbreviation: PC, patient classification.
[a]Cluster analysis.

administration. Patient classification is performed at various times across hospitals, and most hospitals confirm and classify nursing activities over a day during an evening or night shift. Furthermore, it is possible that many nursing records were omitted, such as when nurses who were not accountable for patients provided supportive care. Thus, all nursing activities should be accurately recorded to avoid omission when performing patient classification.

Compared to existing tools, this study was able to develop a patient classification system that can measure nursing intensity in ICUs by incorporating a detailed list of indirect activities, including a smaller number of domains and nursing activities. The domains for the KPCSNIC were determined with reference to the Oulu Patient Classification (OPC) in the RAFAELA system developed in Finland (Fagerström et al., 2000; Rauhala & Fagerström, 2004, 2007). OPCs comprise six domains: (1) nursing activity planning and coordination; (2) respiration, blood circulation and disease symptoms; (3) nutrition and medication administration; (4) personal hygiene and secretion; (5) activity, sleep and rest; and (6) nursing guidance, follow-up management and emotional support. Each domain was rated on a 4-point scale to classify patients into four groups.

In this study, eight domains were used with reference to the OPCs of the RAFAELA system. First, for the circulation subdomain of the symptom management domain, one aspect that differentiates this tool from previous ones is that scores were stratified by classifying different types of fluids while also considering the amount of fluid injected and details of fluid injection. Moreover, infection management, included as a domain, was considered an important component of health facility assessment in Korea, and its subdomains included

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catheter management and isolation. Amid the growing emphasis on patient safety against infections, the fact that infection management was included as one of the domains is highly meaningful. Particularly, scores for catheter management were stratified for maintenance, management and day of catheter insertion, in response to opinions that nursing intensity is high on the day of the catheter insertion. Furthermore, for isolation, different scores were given for droplet and air care for transplant patients. There were opinions to move the day of the continuous veno-venous haemofiltration (CVVH) under the intake and output, and haemodialysis subdomain of the secretion domain.

Another aspect that differentiates our tool from existing ones is that a new domain was developed in this study—nursing guidance and emotional support—which comprised the subdomains of emotional support through communication, hospital admission, transfer, visitor management and family counselling guidance. Visitor management, particularly, has never been investigated as a nursing activity in Korean studies. Education was classified into training of new nurses and education for students. The score for the replacement of facilities and equipment, such as patient-related devices, was set according to the opinion that nursing intensity for that activity is high.

Concerning nursing intensity scores by patient type, the score was highest in patients admitted through the general ward, followed by the emergency department and wheelchair or on foot. Similarly, in Song et al.'s (2010) study, patient classification scores were significantly higher for patients who were admitted through the emergency department (16.03) compared to those admitted through the outpatient clinic (12.66). That is presumed to be because the former group of patients were transferred to the ICU, probably because their conditions had worsened.

Patient classification tools that have been used in the ICU only classified direct nursing activities into different domains to ensure validity. These tools neglected the effects of indirect nursing activities on nursing intensity, thereby failing to accurately reflect reality and underestimating the required nursing staffing. Even studies that examined the effects of indirect nursing activities computed them by measuring nursing hours by considering patients' disease state and nursing skill mix, which may influence work placement of new and experienced nurses and support systems (Urden & Roode, 1997), various events that occur within a work shift such as cardiopulmonary resuscitation, and ward and hospital organizational context. Therefore, these tools relatively underestimate nursing intensity. In other words, these studies only focused on the patient classification tool itself and could not assess various factors that may affect nursing intensity in clinical settings, as they did not assess indirect nursing activities. Hence, this study is noteworthy because it developed a tool that accurately measures nursing intensity by presenting highly specific criteria concerning indirect nursing activities.

4.1 | Study limitations

This study has limitations regarding generalizability as data were only collected from four hospitals in two provinces in Korea. The inability to randomly select patients and nurses further limits the generalization of the results. The data were collected using a subjective questionnaire rather than objective indicators; hence, the study may have limitations regarding its validity. As ICU nurses are often overworked and busy, the accuracy of the measurements using the patient classification tool may be limited. The interrater reliability of the KPCSNIC was tested using the intra-correlation coefficient. In the analysis method, correlation rather than kappa analysis was used, and the comparison of concurrent validity with the currently used patient classification tool also has limitations.

5 | CONCLUSIONS

The KPCSNIC was developed by reviewing relevant literature and establishing clinical validity using the Delphi technique. The finalized tool comprised 44 nursing activities across 18 subdomains and 8 domains. Although the validity and reliability of this tool was tested based on four hospitals in Korea, subsequent studies should apply this tool in a Grade 1 tertiary hospital for nursing fees, and studies should continue to update the cut-off scores for each item of this tool. Future studies that apply the patient classification system to hospitals with patients having high disease severity should be conducted. The tool developed in this study was able to evaluate the nursing needs scores of ICU patients to confirm the nursing activities and needs mainly performed in the ICU. Moreover, it reflected the direct and indirect nursing activities performed in the ICU, and the patient's condition in which the number of hours of nursing activity could be increased. By using this tool, it will be possible to comprehensively evaluate the nursing needs of patients in the ICU and contribute to deriving an appropriate level of nursing staff placement.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

AUTHORSHIP STATEMENT

YKK designed the study and prepared the manuscript. HL and DK collected the data and revised the manuscript critically for important intellectual content. YKK and BP analysed the data and prepared the manuscript. All authors approved the final version for submission and are in agreement with the content of the manuscript.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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REFERENCES

Cho, Y. A., Shin, H. J., Cho, J. K., Jung, M. K., Lee, B. N., & Song, K. J. (2005). Development and application of the Workload Management System for Critical Care Nurses (WMSCN) using WMSN. *Clinical Nursing Research*, *11*, 71–84.

Cho, Y. K., Kim, E. B., Kim, J. Y., Kim, H. S., & Kim, E. H. (2000). Developments of patient classification system in a general hospital. *Clinical Nursing Research*, *5*, 135–158.

Fagerström, L., Rainio, A. K., Rauhala, A., & Nojonen, K. (2000). Professional assessment of optimal nursing care intensity level: A new method for resource allocation as an alternative to classical time studies. *Scandinavian Journal of Caring Sciences*, *14*, 97–104. https://doi.org/10.1111/j.1471-6712.2000.tb00569.x

Ferreira, P. C., Machado, R. C., Martins, Q. C. S., & Sampaio, S. F. (2017). Classification of patients and nursing workload in intensive care: Comparison between instruments. *Revista Gaúcha de Enfermagem*, *38*, e62782. https://doi.org/10.1590/1983-1447.2017.02.62782

Kim, H. J., & Kim, K. H. (2011). Verification of validity of MPM II for neurological patients in intensive care units. *Journal of Korean Academy of Nursing*, *41*, 92–100. https://doi.org/10.4040/jkan.2011.41.1.92

Kim, K. Y., & Jang, K. S. (2002). The study of critical indicator development for establishing patient classification system in the intensive care unit. *Journal of Korean Academy of Nursing Administration*, *8*, 475–488.

Lee, K. O., Shin, H. J., Park, H. A., Jeong, H. M., Lee, M. H., Choi, E. H., Lee, J. M., Kim, Y. J., Sim, Y. K., & Park, K. J. (2000). Patient severity classification in a medical ICU using APACHE III and patient severity classification tool. *Journal of Korean Academy of Nursing*, *30*, 1243–1253. https://doi.org/10.4040/jkan.2000.30.5.1243

Lundgrén-Laine, H., & Suominen, T. (2007). Nursing intensity and patient classification at an adult intensive care unit (ICU). *Intensive & Critical Care Nursing*, *23*, 97–103. https://doi.org/10.1016/j.iccn.2006.10.006

Lynn, M. R. (1986). Determination and quantification of content validity. *Nursing Research*, *35*, 382–385. https://doi.org/10.1097/00006199-198611000-00017

Miranda, D. R., Nap, R., de Rijk, A., Schaufeli, W., Iapichino, G., & the Therapeutic Intervention Scoring SystemWorking Group. (2003). Nursing Activities Score. *Critical Care Medicine*, *31*, 374–382. https://doi.org/10.1097/01.CCM.0000045567.78801.CC

Mokkink, L. B., Terwee, C. B., Knol, D. L., Stratford, P. W., Alonso, J., Patrick, D. L., Bouter, L. M., De Vet, & H. C. (2010). The COSMIN checklist for evaluating the methodological quality of studies on measurement properties: A clarification of its content. *BMC Medical Research Methodology*, *10*, 22. https://doi.org/10.1186/1471-2288-10-22

Moon, S. N., Kim, Y. J., Park, J. H., & Choi, J. A. (2007). A fundamental study to measure the nursing workload in military hospitals—Grouping a list of direct/indirect nursing activities and producing an average nursing minutes by processing a nursing activities time. *Journal of Military Nursing Research*, *25*, 63–68.

Padilha, K. G., de Sousa, R. M., Queijo, A. F., Mendes, A. M., Reis Miranda, D. (2008). Nursing Activities Score in the intensive care unit: analysis of the related factors. *Intensive Critical Care Nursing*, *24*, 197–204.

Padilha, K. G., Stafseth, S., Solms, D., Hoogendoom, M., Monge, F. J., Gomaa, O. H., Giakoumidakis, K., Giannakopoulou, M., Gallani, M. C., Cudak, E., de Souza Nogueira, L., Santoro, C., de Sousa, R. C., Barbosa, R. L., & Miranda, D. D. R. (2015). Nursing Activities Score: An updated guideline for its application in the intensive care unit. *Revista da Escola de Enfermagem da USP*, *49*, 131–137. https://doi.org/10.1590/S0080-623420150000700019

Palese, A., Comisso, I., Burra, M., DiTaranto, P. P., Peressoni, L., Mattiussi, E., & Lucchini, A. (2016). Nursing Activity Score for estimating nursing care need in intensive care units: Findings from a face and content validity study. *Journal of Nursing Management*, *24*, 549–559. https://doi.org/10.1111/jonm.12357

Rauhala, A., & Fagerström, L. (2004). Determining optimal nursing intensity: The RAFAELA method. *Journal of Advanced Nursing*, *45*, 351–359. https://doi.org/10.1046/j.1365-2648.2003.02918.x

Rauhala, A., & Fagerström, L. (2007). Are nurses' assessments of their workload affected by non-patient factors? An analysis of the RAFAELA system. *Journal of Nursing Management*, *15*, 490–499. https://doi.org/10.1111/j.1365-2834.2007.00645.x

Reis Miranda, D., & Jegers, M. (2012). Monitoring costs in the ICU: A search for a pertinent methodology. *Acta Anaesthesiologica Scandinavica*, *56*, 1104–1113. https://doi.org/10.1111/j.1399-6576.2012.02735.x

Seong, J. S. (2013). *Usefulness of Charlson Comorbidity Index (CCI) and Acute Physiology Age Chronic Health Evaluation III (APACHE III) on prediction of health care outcomes of intensive care unit patients*. [Unpublished master's thesis]. Chungnam National University.

Song, K. J., Kim, E. H., Yoo, C. S., Park, H. A., Song, M. S., & Park, K. O. (2010). Verification of reliability and validity of KPCS-1 and estimation of nursing time conversion index. *Journal of Korean Clinical Nursing Research*, *16*, 127–140.

Stafseth, S. K., Tønnessen, T. I., My Diep, L., & Fagerstrøm, L. (2018). Testing the reliability and validity of the Nursing Activities Score in critical care nursing. *Journal of Nursing Measurement*, *26*, 142–162. https://doi.org/10.1891/1061-3749.26.1.142

Sung, Y., Song, M. S., & Park, J. (2007). Estimation of nursing costs by a Patient Classification System (PCS) in ICU. *Journal of Korean Academy of Nursing*, *37*, 373–380. https://doi.org/10.4040/jkan.2007.37.3.373

Upenieks, V. V., Kotlerman, J., Akhavan, J., Esser, J., & Ngo, M. J. (2007). Assessing nursing staffing ratios: Variability in workload intensity. *Policy, Politics & Nursing Practice*, *8*, 7–19. https://doi.org/10.1177/1527154407300999

Urden, L. D., & Roode, J. L. (1997). Work sampling: A decision-making tool for determining resources and work redesign. *Journal of Nursing Administration*, *27*, 34–41. https://doi.org/10.1097/00005110-199709000-00009

Yoo, C. S., & Kim, K. S. (2013). Development of classification system for critical care nursing based on nursing needs. *Journal of Korean Clinical Nursing Research*, *19*, 33–44. https://doi.org/10.22650/JKCNR.2013.19.1.33

You, Y. Y., Min, Y. G., Ahn, J. H., Choi, S. C., Shin, Y. H., Jung, Y. S., & Park, E. (2011). Prediction of mortality in patients with acute paraquat intoxication using Simplified Acute Physiology Score II. *The Korean Journal of Critical Care Medicine*, *26*, 221–225. https://doi.org/10.4266/kjccm.2011.26.4.22

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