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Development and validation of instrument for assessment of situational awareness in operational management of nursing leaders in hospital settings

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Abstract

Nursing leaders in charge of operational management in acute care environments need continuous real-time information regarding workflow, human resources, and patient situations to support their immediate decision making. However, nursing leaders report that the current information systems do not provide sufficient support to help their decision making. The aim of this study was to develop an instrument for the evaluation of situational awareness of nursing leaders in operational management into the hospital setting. First, an established situational awareness scale was combined with literature to develop a draft for the instrument. Second, an expert panel assessed the content validity of the instrument, and finally, the psychometric properties of the instrument were evaluated by a cross-sectional online survey. The final version of the instrument consisted of three dimensions: Demands of patient care (5 items), Human resources (5 items) and Materials (6 items). The scale content validity index for all 16 items was 0.88. The instrument was tested with nursing professionals in charge of operational management (n=349). The overall situational awareness was 4.18, the highest dimension was the human resources (mean 4.63), while lowest score was seen for the dimension patient care (mean 3.84). The construct validity and internal consistency of the instrument was deemed good. The instrument may support systematic assessments of situational awareness, pinpointing areas of information management that need improvement. It may support evaluation of development projects, interventions, or implemented information systems. As situational awareness is an integral element of operational management in all health care, future research should explore it in other clinical environments and with other professions.

Keywords: hospitals, information systems, nursing care, situational awareness

Introduction

Nursing leaders in charge of operational management in acute care environments need continuous real-time information regarding workflow, human resources, and patient situations to support their immediate decision making [1–3]. Acquiring, collecting and using the needed information can be difficult, as the information is scattered in different information systems [4,5]. Moreover, nursing leaders report that the current information systems do not provide sufficient support to help their decision making [1,5,6]. The day-to-day decisions made within the stressful and complex acute care environments have direct patient and organizational impact, resulting in a need to further develop novel systems and models to support decision making [7].

Situational awareness is a hierarchical process preceding decision making and action, starting with a perception of the elements in the current situation, followed by a comprehension of their meaning and ending with a projection of future events [8]. Situational awareness refers to the ongoing, constantly evolving situation [9]. It requires constant vigilance, which needs to be maintained with continuous training, practice, briefing and assessment. In clinical settings, failure to obtain situational awareness has a direct effect on patient care and outcomes, posing a threat to patient safety [10–12]. The importance of situational awareness in nursing context is well recognized [13], but in nursing and health care management the research is still limited in studying individual phenomena, for example patient flow management model development [14].

Different models for assessing situational awareness are predominantly adapted from aviation. One widely used instrument to assess situational awareness is The Situation Awareness Global Assessment Technique (SAGAT), providing snapshots of self assessed situational awareness, collected at random points in time in a specific setting [15]. In health care, SAGAT has been successfully applied in education, for example in assessing situational awareness of medical and surgical trainees as well as multidisciplinary teams in high-fidelity trauma and acute care simulation scenarios [16–18]. Research on evaluating situational awareness in clinical settings and health care management is still lacking. Hence, the aim of this study was to develop and test an instrument for the evaluation of situational awareness of nursing leaders in operational management into the hospital setting. The research tasks were (1) to describe the central elements of operational management in nursing and, based on the results, to draft an instrument for the assessment of situational awareness and evaluate its face and content validity and 2) to assess the internal consistency and construct validity of the instrument.

Material and methods

Design

The study was conducted in three stages applying the scale development procedure introduced by DeVellis [19]. The first stage, the conceptualization of concepts and drafting the instrument, combined an established situational awareness scale used in aviation [8] with scientific literature on nursing management to develop a draft for the instrument. The second stage was an expert panel to assess the content validity of the drafted instrument, followed by modifications made to the instrument based on the assessments and feedback provided by the experts. Finally, on the third stage, the psychometric properties of the instrument were evaluated by conducting a cross-sectional electronic survey.

Item pool and designing the format for instrument

The instrument was built on principles from the SAGAT [8], dividing situational awareness in three steps: perception, understanding and projection. The management -related content for the instrument was derived from a literature review that mapped the essential elements of managerial activities relevant to situational awareness and the processes preceding decision making in the operational management of hospitals. Five databases were searched (including CINAHL, Cochrane database, PubMed, Scopus and Web of Science) using different synonyms based on the PICo-strategy [20] and database specific terms (i.e. MeSH-terms and CINAHL headings):

- Population: nursing leader (e.g., nurse manager, charge nurse)
- Interest: operational management (e.g., operational decision making, first-line management)
- Context: hospital setting (e.g., emergency unit, intensive care unit, inpatient unit)

A total of 2550 references were identified in the database searches (PubMed=1316, CINAHL=506, Cochrane=27, Scopus =527 and Web of Science =174). After removal of duplicates a total of 2314 references remained. Articles were excluded based on title and abstract review and a total of 196 full text articles were reviewed. Finally, 112 articles were included in the review. Reference lists of the articles of interest were screened manually for more relevant literature. Data regarding managerial activities and information needs related to the operational management were extracted and categorized into three main dimensions 1) aspects on patient health conditions and care needs (patients), 2) aspects on human resources and their sufficiency (human resources), and 3) aspects on examination, procedure and care related equipment including state and sufficiency (materials). These findings were then merged with the theoretical structure of the SAGAT to develop the first draft of the instrument for the evaluation of situational awareness.

Evaluation of content validity

To assess the content validity of the first draft of the instrument, an expert panel was established using purposive sampling during the autumn 2019. The expert panel consisted of eight experts representing different perspectives related to operational management, such as nurse managers and assistant nurse managers within different areas in hospitals. Using the content validity index (CVI) [21,22], the content relevance of each individual item of the instrument was rated using a four-point rating scale, of which 1 = not relevant, 2 = somewhat relevant, 3 = quite relevant and 4 = highly relevant. The item CVI (I-CVI) was calculated for each scale item rated as quite or highly relevant, dividing the prevalence of 3 or 4 scores by the number of professionals in the expert panel. The overall scale CVI (S-CVI) was calculated from the total number of items deemed content valid. The criterion for acceptability was set to 0.75 for I-CVI and 0.8 for S-CVI for this study. The experts were also encouraged to give open feedback of the instrument as well as evaluate the face validity of the instrument's user instructions. The feedback was analyzed using the content analysis methods [23]. Modifications were made to the instrument based on the feedback resulting in the finalization of the instrument.

In addition to the items validated by the expert panel, a few items describing participant characteristics were added to the instrument, including gender, working time (office hours, outside office hours or both), position, setting, work experience (in years) and managerial work experience (in years). Participants were additionally asked to describe

their managerial activities by rating their frequency of immediate ("right here, right now") decisions related to 9 aspects (items) of operational management (such as "patient flow" and "placement of human resources") on a scale of 1-5, on a scale from 1 to 5, where 1 = daily, 2 = weekly, 3 = monthly, 4 = less than monthly and 5 = never. This was adapted from [6] and further developed based on the literature review used for the item pool. The final version of the tool is available at https://sites.utu.fi/nursingscienceresearchprogrammes/connected-health-utu/

Evaluation of internal consistency and construct validity of the instrument

The final instrument was tested by conducting a cross-sectional electronic survey in the late autumn 2019 and early spring 2020. The participants (n=349) were recruited from two hospital districts in Finland using a purposive sampling method, representing nursing professionals in charge of operational management in different hospital units. On office hours, the professionals in charge are usually immediate supervisors, such as nurse managers and assistant nurse managers. During the evenings, nights and weekends, the responsibilities are delegated to suitable professionals working on those shifts, such as the most experienced nurse.

Statistical analyses

Reliability was evaluated by internal consistency using the Cronbach's α, the split-half-method and item-to-total correlation. Kaiser-Meyer-Olkin (KMO) was used to test if factor analysis was appropriate to be used. The Bartlett test was used to assess sphericity. P-values <0.05 were considered statistically significant. To confirm the theoretical results of the literature review, we performed a confirmatory factor analysis. The goodness-of-fit values used in this study were chi-square (x2), degrees of freedom (df), Tucker-Lewis index (TLI), comparative fit index (CFI), root mean square residual (RMR) and root mean square error of approximation (RMSEA). The statistical analyses were done using R version 4.0.2.

Ethical considerations

The study held an ethical review statement 9/2019 issued by the University of Turku Ethics Committee for Human Sciences (Health Care Division) and HUS/3307/2019 issued by the Hospital District of Helsinki and Uusimaa. It was also granted administrative approvals (J31/19 and HUS/256/2020) by the hospital districts.

Results

The development and content validity of the instrument

The first draft of the instrument contained 16 items divided into three dimensions of central elements derived from the research literature: *Patients* (5 items), *Human resources* (5 items) and *Materials* (6 items). The individual items within the dimensions followed the SAGAT, moving from knowledge of the current situation (e.g., "I know the real time needs") through the ability to anticipate expected needs or occurrences ("I know how the situation will change") to the ability to anticipate the needed actions ("I know what I will do, if"). Each individual item was assessed using a Likert scale ranging from 1 = strongly disagree to 5 = strongly agree (with 6 = does not apply to me).

The draft version of the instrument was evaluated by an expert panel of eight professionals. The professionals worked as nurse managers (n=5), assistant nurse managers (n=2) and administrative nurse managers (n=1). Their areas of specialty care were internal medicine and surgical units (n=4),

musculoskeletal diseases (n=1), women and infants (n=1), medical imaging (n=1) and children and adolescents (n=1). The health care work experience varied from 15 to 37 years (mean 26.38, SD 8.98) and managerial work experience from 1.5 to 19 years (mean 10.94, SD 6.34).

The S-CVI for all items was 0.88, with two items having a I-CVI under 0.75. These items concerned knowledge of medication resources (I-CVI 0.63) and knowledge of material resources (I-CVI 0.63) under the dimension *materials*. Following the feedback provided by the panel, modifications were made to all items. Examples include changing the expressions "real time" to "at this moment" and some of the expressions "I know" or "I have decided" to "I can anticipate" or "I can estimate". Additionally, examples were added to clarify the items. The dimensions were reworded to D1: *Demands of patient care* (5 items), D2: *Human resources* (5 items) and D3*: Materials (e.g. care- and test equipment, medication)* (6 items).

Construct validity and internal consistency of the developed instrument

Construct validity and internal consistency of the instrument were tested through a cross-sectional survey (n=349). Of the participants 322 (93%) were female, working predominantly as nurse managers (n=179, 52%) or assistant nurse managers (n=126, 36%) in different areas of specialty care, such as psychiatry (n=42, 12%), surgical care (n=39, 11%) and general medicine (n=34, 10%). Most of the participants reported working during office hours (n= 277, 80%). Health care work experience varied between four and 44 years (mean 24.99, SD 8.90), whereas managerial work experience between <1 and 39 years (mean 10.00, SD 7.84). The demographics of the participants are explained in detail in table 1.

Table 1. Demographics of the participants.

Demographics	n	%
Gender		
Female	322	93.3
Male	21	6.1
Other	2	0.6
Professional role		
Nurse manager	179	51.7
Assistant nurse manager	126	36.4
Shift manager	40	11.6
Other	1	0.3
Working hours		
Office hours (approximately 8 am to 4pm on weekdays)	277	80.1
Outside office hours	12	6.1
All shifts	57	16.5
Area of specialty care		
Psychiatry	42	12.1
Surgical care	39	11.2
General medicine	34	9.8
Women and infant care	33	9.5
Intensive care and surgery	33	9.5
Musculoskeletal diseases	28	8.0
Cardiology	27	7.8
Acute care	26	7.5
Children and adolescents	24	6.9
Abdominal surgery and urology	14	4.0
Neurology	14	4.0
Laboratories	14	4.0
Medical imaging	11	3.2
Other	9	2.6

Participants reported the frequency of the need to make immediate decisions related to operational management as presented in Figure 1. The most common decisions related to the placement of staff (79% responded doing this daily or weekly), addressing grievances (77% responded doing this daily or weekly), the number of staff (71% responded doing this daily or weekly), patient flow (69% responded doing this daily or weekly) and negotiations with stakeholders (69% responded doing this daily or weekly). An additional 16 % of the participants reported making other daily or weekly decisions than those included in the items. The open-ended responses that followed, showed other administrative duties such as occupational safety or student placement related issues.

The overall reported situational awareness was 4.18. The dimension *human resources* (mean 4.63) received the highest scores, with the item knowledge of the current number of human resources (mean 4.91) and competence of the staff (mean 4.79) on the work shift scoring best, as shown in table 2. The lowest situational awareness

average was reported for the dimension *demands of patient care* (mean 3.84).

The Cronbach's α measured for the instrument was 0.86 (D1*: Demands of patient care* 0.75, D2: *human resources* 0.78 and D3: *materials* 0.84). Confirmatory factor analysis (KMO=0.84, Bartlett's test p<0.001) was performed for the 16 items. The goodness of fit values were x2 = 2367.02, df = 120, p < 0.001, TLI = 0.74, CFI = 0.78, RMR = 0.10 and RMSEA = 0.12. Internal consistency measures are presented in table 2 and confirmatory factor analysis in table 3.

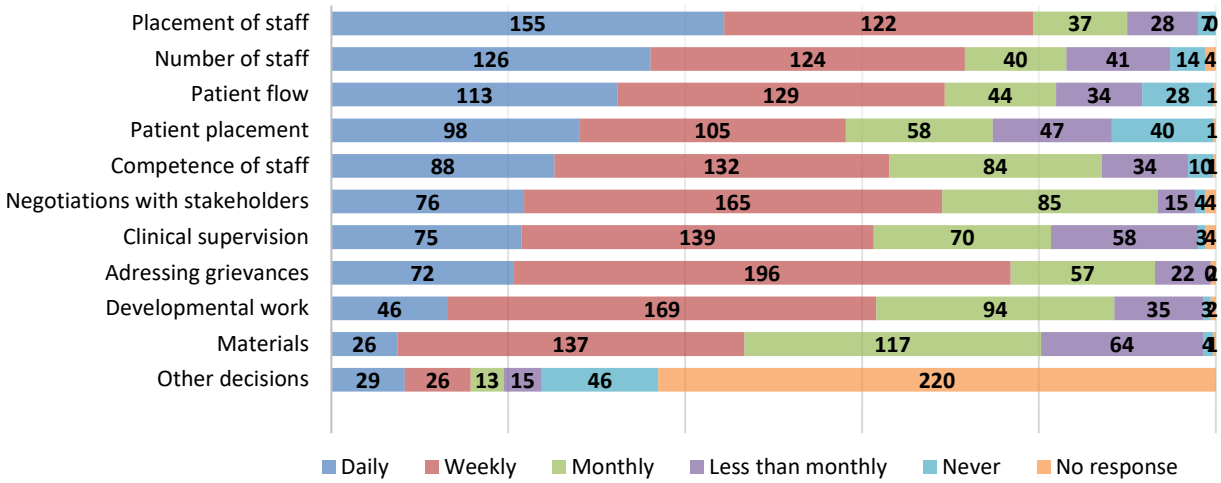

Figure 1. Frequency of immediate decisions related to operational management presented as percent (100% per bar) with numbers of responses per response alternatives shown on the bars.

Table 2. Situational awareness as evaluated by professionals in charge of operations management and the internal consistency measures of the instrument.

Dimension and items of situational awareness	N	Mean*	SD	Item-to-tal correlation	Cronbach's α	Spearman-Brown coefficient
D1: Patient care	**330****	**3.84**	**0.75**		**0.75**	**0.80**
D1.1 Knowledge of the current number of patients in the unit	348	4.64	0.80	0.40		
D1.2 Knowledge of the current care needs of the patients	347	3.98	1.13	0.53		
D1.3 Ability to anticipate the expected changes in the number of patients during the work shift	348	3.71	1.49	0.41		
D1.4 Ability to anticipate the expected changes in patient care needs during the work shift	345	3.56	1.40	0.54		
D1.5 Ability to anticipate the actions to take if changes unexpectedly occur	347	4.26	1.05	0.51		
D2: Human resources	**345****	**4.63**	**0.48**		**0.78**	**0.73**
D2.1 Knowledge of the current number of human resources on the work shift	349	4.91	0.46	0.37		

D2.2 Knowledge of the current competence of staff on the work shift	349	4.79	0.51	0.40		
D2.3 Ability to estimate the changes in human resources during the work shift	347	4.60	0.75	0.39		
D2.4 Ability to estimate the sufficiency of human resources during the work shift	348	4.60	0.71	0.52		
D2.5 Ability to anticipate actions to ensure the sufficiency of the human resources	348	4.34	0.89	0.49		
D3: Materials	**341****	**4.05**	**0.74**		**0.84**	**0.74**
D3.1 Knowledge of currently available beds or appointments in the unit	348	4.62	0.91	0.48		
D3.2 Knowledge of currently available material resources in the unit	347	4.41	0.94	0.58		
D3.3 Knowledge of currently available medication resources in the unit	349	4.32	1.29	0.51		
D3.4 Ability to anticipate the expected material resources during the shift	348	3.98	1.25	0.58		
D3.5 Ability to estimate the sufficiency of the current material resources during the shift	349	4.23	1.09	0.58		
D3.6 Ability to anticipate actions to ensure the sufficiency of the material resources	349	4.21	1.10	0.60		
Situational awareness on average	**332****	**4.18**	**0.53**		**0.86**	**0.75**

*Using scale of 1-5, of which 1 = strongly disagree and 5 = strongly agree, with 6 = does not apply to me
**Answers stating "6 = does not apply to me" removed from the dimension and situational awareness averages

Table 3. Confirmatory factor analysis of instrument items.

Item	Item name	Factor		
		1	2	3
D1.4	Ability to anticipate the expected changes in patient care needs during the work shift	0.825		
D1.2	Knowledge of the current care needs of the patients	0.547		
D1.3	Ability to anticipate the expected changes in the number of patients during the work shift	0.718		
D1.1	Knowledge of the current number of patients in the unit	0.347		
D1.5	Ability to anticipate the actions to take if changes unexpectedly occur	0.606		
D2.4	Ability to estimate the sufficiency of human resources during the work shift		0.801	
D2.2	Knowledge of the current competence of staff on the work shift		0.583	
D2.3	Ability to estimate the changes in human resources during the work shift		0.674	
D2.1	Knowledge of the current number of human resources on the work shift		0.577	
D2.5	Ability to anticipate actions to ensure the sufficiency of the human resources		0.641	
D3.5	Ability to estimate the sufficiency of the current material resources during the shift			0.823
D3.2	Knowledge of currently available material resources in the unit			0.673
D3.3	Knowledge of currently available medication resources in the unit			0.647
D3.4	Ability to anticipate the expected material resources during the shift			0.819
D3.1	Knowledge of currently available beds or appointments in the unit			0.348
D3.6	Ability to anticipate actions to ensure the sufficiency of the material resources			0.775

Discussion

This study has two main findings. First, the instrument may be used to measure situational awareness of nursing leaders in hospital operational management with dimensions related to the demands of patient care, human resources, and materials. Overall, the content validity of the new instrument was good, however the construction of the instrument requires further development. Second, the study gives a snapshot of situational awareness of nursing leaders in operational management in hospitals and pinpoints areas that need development. Participants reported quite good scores of situational awareness overall. However, there is still room for improvement, as results indicate deficiencies in a comprehensive situational awareness (covering all dimensions) crucial to operational management [11,24]. Further, the frequency of managerial activities related to human resources were aligned with the reported situational awareness, where situational awareness on human resources (D2) scored highest. However, the dimension related to patient care was weaker although these decisions also were made quite frequently. This indicates a clear need to develop information systems to better support access to patient related information. Hospitals typically have several digital information systems for patient care, but how this serves operational management is less explored.

The failure to achieve the best possible situational awareness is most likely to occur during perception at the very beginning of the decision making process, as it might be affected by limited knowledge or misperception of the overall picture [11]. Prior research shows that contemporary systems do not support operational management in nursing sufficiently [1,2,5]. Research describing the informational needs of nursing leaders in operational management generally disclose issues in obtaining relevant information in real time, highlighting the need to develop user-designed information systems [1,3,6]. Subsequently, developing novel decision support systems to support operational management would benefit from a thorough investigation regarding their effect on the situational awareness of the end user with evaluations continuing throughout the entire development and implementation process.

Although recent work is done to improve shared situational awareness [25], more research is still clearly needed in this area [24]. When looking at specific actions reported by the respondents, further exploration is needed to evaluate the appropriateness of information systems and processes to support communication in operational management for shared situational awareness. The importance of shared situational awareness in the hospital setting has been emphasized as one crucial component to patient safety [26,27].

The study has limitations. First, the instrument could have benefitted from a final round of CVI assessment by experts as only the first version was evaluated for CVI. But changes made at this stage were small and therefore there was little expectation for change to CVI values. Additionally, two of the items had low loadings. The structure of the instrument was drafted based on the literature review and was not fully perfect, which may be due to data inconsistencies related to different responsibilities of leaders in different environments, which is typical in nursing leaders' operational management [6]. However, instrument development processes are typically long processes and this needs to be acknowledged in further development of the instrument.

In conclusion, the developed instrument could be utilized in systematic assessments of the current state of situational awareness, pinpointing areas

related to operation management in need of development. However, the construction of the instrument requires further development before moving forward. The instrument has the potential for evaluating desired changes or effects of development projects, interventions, or implemented information systems. As situational awareness is an integral element of operational management in all health care contexts, future research should explore possibilities to further develop the instrument in other clinical environments and with other professions.

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Conflict of interest

None.

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