Establishing nursing adverse events' reporting content of hospital: using the Delphi method

Original article

Yue Liu^a, Hua-Ping Liu^{b,*}

^aRainbowfish Rehabilitation & Nursing School, Hangzhou Vocational & Technical College, Hangzhou, Zhejiang 310018, China

^bSchool of Nursing, Peking Union Medical College, Beijing 100144, China

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Abstract: **Objective:** To develop nursing adverse events' reporting content of hospital.

Methods: The study included two phases. The first phase was to develop the category and definition of nursing adverse events that need to be reported through an expert meeting. The second phase was to develop every nursing adverse event's reporting content by using the Delphi method. In total, 8 experts attended the meeting and 15 experts conducted two rounds of consultation letter.

Results: Nursing adverse events that need to be reported of hospital include pressure sore, fall/falling from bed, unplanned extubation, medication error, and accident. Reporting content of these events in detail had also been obtained, which was helpful for cause analysis systematically.

Conclusions: The reporting content of the nursing adverse event of hospital is established, and it is a basis for further study of the development of nursing adverse event reporting and feedback system.

Keywords: nursing adverse event • reporting content • expert meeting • Delphi method • Swiss Cheese Model • adverse event report

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1. Introduction

Medical adverse events would increase the clinical events, such as readmission, death, length of stay in hospital, and lead medical care providers to experience negative emotional symptoms.¹⁻⁴ Nursing adverse event would contribute to tell the risk, provide nurse training with reference, prevent the happening of similar events again, and offer evidence to continuing quality improvement.^{5,6} There has not been unified or specific nursing adverse event reporting content in the Chinese

mainland. Reporting content in that region generally had some shortcomings, for example, lacking unified or specific category of nursing adverse events and agreement on their definition, reporting content was not beneficial for data analysis or feedback, the discussion of systematic factors need to deepen.^{7,8} Swiss Cheese Model was a popular theoretical framework in the analysis of medical adverse events.^{9,10} According to this theory, adverse events were caused by the combined effect of several factors (systematic, personal, and

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* Corresponding author.

E-mail: huapingliu@vip.126.com (H.-P. Liu).

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environmental factors). These factors were like pieces of cheese that were stacked up. There were shortcomings in factors, like holes in cheese. When the holes in different pieces of cheese communicated accidentally and developed into a drill way, light would transmit through. This could be compared to the happening of adverse events.¹¹ Based on the Swiss Cheese Model, this study developed a reason analysis part of reporting content from systematic, personal, and environmental factors, and aimed to establish nursing adverse events' reporting content of hospital.

2. Methods

2.1. Expert meeting

2.1.1. Materials compilation for expert meeting

Materials for the expert meeting were formed by literature review and reference of nursing adverse event reporting content of hospitals domestic and abroad.

2.1.2. Selection of experts

The inclusion criteria included experts who had worked in a hospital for more than 10 years, had a bachelor's or higher degree, were familiar with nursing quality control, and voluntary for the study. Totally eight experts attended the meeting. Seven experts were from a tertiary hospital, with one from the secondary hospital. Nursing quality control and improvement center approved of this selection of experts.

2.2. Delphi method

2.2.1. Task team establishment

The task team consisted of a graduate student, a tutor, and an instructor. Team members achieved missions including questionnaire design, expert selection, data collection, consultation information feedback, and statistical analysis.

2.2.2. Questionnaire compilation for expert consultation

The consultation questionnaire was developed based on literature review and reference of nursing adverse event reporting content at home and overseas. This questionnaire contained the following: (1) Instructions of the research background, time returned, contact information, and acknowledgment. (2) An evaluation form of nursing adverse event reporting content of hospital in detail, in which a score of 1–5 was assigned to denote the least to the most important item in sequence. The evaluated content was set by general reporting content

and individual one. And individual reporting content was expanded from five events, namely pressure sore, fall/falling from bed, unplanned extubation, medication error, and accident. Meanwhile, every event's reporting content was comprised of the event description, reason analysis, and event consequence. According to the Swiss Cheese Model, the reason analysis portion covered systematic, personal, and environmental factors. (3) A form for gathering expert's general information, determining familiarity with consultation and self-assessment.

2.2.3. Selection of experts

The inclusion criteria included experts who had worked in hospital or nursing school for more than 10 years, had a bachelor's degree or higher, were familiar with nursing quality control, and voluntary for the study. The literature indicated that 15–50 experts would be appropriate.¹² Totally 15 experts participated in the consultation. Among them, 12 were from tertiary hospitals, 2 from secondary hospital, and 1 from nursing school. Nursing quality control and improvement center approved this selection of experts.

2.2.4. Two-round consultation

In two rounds on consultation, questionnaires were distributed and retrieved by task team members in person.

2.2.5. Establishment of filtering criteria

Based on the literature review, items with a score of <3.5 or variable coefficient >0.3 would be removed.¹³ Items would be added, removed, or modified by opinions of the experts and discussion of task team members.

2.3. Statistical analysis

Data analysis was conducted by SPSS 19.0. Mean and standard deviation was used in descriptive analysis, which yielded general information, authority, and coefficient. Testing for coordination coefficient which was statistically different ($p < 0.05$) was considered significant.

3. Results

3.1. General characteristics of the experts

The mean age of experts who attended the meeting was 46.25 ± 6.84 years. Six experts had worked for >20 years and the mean of the whole working time was

26.12 ± 7.40 years. One expert had a doctor's degree, one had a master's degree, and the rest had a bachelor's degree. Among 8 experts who attended the meeting, the number of those who held senior, vice senior and the intermediate title was 4, 2 and 2, respectively.

The mean of Delphi consultation experts' age was 44.73 ± 5.74 years and the mean of their working time was 23.73 ± 5.48 years. One expert had a doctor's degree, two had a master's degree, and the rest had a bachelor's degree. Among 15 Delphi consultation experts, the number of those who held senior, vice senior, and the intermediate title was 5, 4, and 6, respectively.

3.2. Initiative coefficients

As all questionnaires were distributed and retrieved by task team members in person, 100% questionnaires had been collected in two-round consultation. A total of 14 experts (93.33%) proposed constructive suggestions in the first round, with 12 experts (80%) in the second round.

3.3. Authority coefficients

An authority coefficient (Cr) depends on the familiarity with the field (Cs) and criterion (Ca), i.e., $Cr = (Cs + Ca)/2$.¹² Six degrees of familiarity were valued from 0.0 to 0.9, indicating the lowest to the highest familiarity in an arithmetic sequence.¹² Criteria were divided into more, medium, and less in sequence, including theoretical analysis (0.3, 0.2, and 0.1), practical experience (0.5, 0.4, and 0.3), literature at home and abroad (0.1, 0.1, and 0.1), and subjective judgment (0.1, 0.1, and 0.1). The authority coefficient of meeting experts was 0.869, with 0.938 familiarity and 0.800 criterion. When it comes to Delphi consultation experts, the authority coefficient was 0.867, with 0.900 familiarity and 0.833 criterion.

3.4. Coordination coefficients

Coordination depends on variable and coordination coefficients.¹² The mean of variable coefficients in the first and second round was 0.21 and 0.14, respectively. And the coordination coefficient in the first round was 0.543, with which was 0.629 in the second round. Both coefficients were significantly different ($p < 0.01$). Tables 1 and 2 list the data obtained in detail.

3.5. Category and definition of nursing adverse events that need reported

Through the discussion of the expert meeting, nursing adverse events that need to be reported included pressure sore, fall/falling from bed, unplanned extubation,

Round	Kendall's W	χ^2	p
1	0.543	1377.607	0.00*
2	0.629	938.597	0.00*

Note: * $p < 0.01$.

Table 1. Coefficients and significance testing results.

Items	M ± SD	CV
General reporting content of nursing adverse event	4.28 ± 0.76	0.18
Individual reporting content of nursing adverse event		
<i>Pressure sore</i>		
Event description	4.54 ± 0.60	0.14
Reason analysis	4.50 ± 0.60	0.14
Event consequence	4.24 ± 0.75	0.18
<i>Fall/Falling from bed</i>		
Event description	4.51 ± 0.65	0.15
Reason analysis	4.49 ± 0.62	0.14
Event consequence	4.38 ± 0.69	0.16
<i>Unplanned extubation</i>		
Event description	4.54 ± 0.62	0.14
Reason analysis	4.53 ± 0.60	0.13
Event consequence	4.46 ± 0.69	0.16
<i>Medication error</i>		
Event description	4.70 ± 0.54	0.12
Reason analysis	4.46 ± 0.66	0.15
Event consequence	4.57 ± 0.57	0.13
<i>Accident</i>		
Event description and reason analysis	4.59 ± 0.56	0.12
Event consequence	4.49 ± 0.63	0.14

Note: CV: coefficient of variation.

Table 2. Means, standard deviations, and variable coefficients of items.

medication error, and accident. The definitions of these events are shown in Table 3.

3.6. Consultation

According to the result of two-round consultation, the general reporting content of nursing adverse event contains the following: (1) Basic information of nursing adverse event, that is, time event happened, time event was found, time event was reported, patient's type, event finder, event reporter. (2) Nurse's basic information, that is, education background, professional title, personal working time, and working time in this department. (3) Patient's basic information, that is, sex, age, medical record No., nursing care level, education

Event	Definition	Individual reporting content					Event consequence
		Event description	Reason analysis				
			Systematic factors	Patient's factors	Medical staff factors	Environmental factors	
Pressure sore	Partial injury of skin and subcutaneous tissue, usually happened in bone carina, caused by pressure or/and shear force in general	Part and classification, nosocomial happening, history of pressure sore, action ability, risk assessment, ADL grade, accompanist, measures taken before event happening.	Systematic factors: average number of patients nurses in this ward taking care of.	Patient's factors: stay in bed, hormone used, hypoproteinemia, dyspraxia, anemia, obesity, edema, diarrhea, gatism, urinary catheter indwelling, forced position, infection, coma, skin feeling injury, restraint, operation, pressure dressing.	Medical staff factors: turning over, skin cleaning, catheter fixation, nursing equipment used.	Environmental factors: bed cleaning.	
Fall/falling from bed	Falling: Influenced by internal and external factors, one couldn't maintain his erect posture due to posture change or function failure, and fall down to floor or lower plane. Falling from bed: According to sudden, involuntary and unintentional position change, one fall from bed.	Place, history of fall/falling from bed, accompanist, risk assessment, ADL grade, pain assessment, measures taken before event happening	Systematic factors: number of patients the nurse taking care of, nurse's training of relative knowledge.	Patient's factors: mental state, conscious state, state when falling happened, disease, drug, action ability.	Medical staff factors: health education, help patients who were bad in action, bedside rail used.	Environmental factors: ponding, slippery floor, uneven ground, too many barriers, lines placed randomly by patients or their relatives, bed overtopped, bed's brake unfixed, inappropriate light, lack of handrail, lack of warning sign, warning sign failed to work.	
Unplanned extubation	Extubation or catheter shifting without medical staff agreement, including extubation caused by inappropriate operation.	Place, catheterizing time, type of catheters, history of unplanned extubation, situation when unplanned extubation happened, way of fixing, accompanist, ADL grade, pain assessment.	Systematic factors: number of patients the nurse taking care of, nurse's training of relative knowledge, air sac or water suture breakage, defective operation procedure.	Patient's factors: mental state, conscious state, drug, restraint, extubation while getting rid of restraint, extubation when patient's relatives didn't understand, patient with cognitive impairment extubated himself, extubation when couldn't tolerant uncomfortable catheterizing, forced position, extubation while sneezing or vomiting, catheters stretched.	Medical staff factors: restrain in time, catheters inappropriate fixed, catheters stretched, health education.	Environmental factors: catheters twined.	
						Drug extravasation, skin and mucosa injury, tube plugging, bleeding, asphyxia, pneumothorax, air embolism, thrombus, catheterizing again, anastomotic fistula, operation or rescue, infection, disability or death, further treatment received in other medical organizations.	

(continued)

Event	Definition	Individual reporting content					Event consequence
		Event description	Reason analysis			Environmental factors	
			Systematic factors	Patient's factors	Medical staff factors		
Medication error	Drug patients received actually wasn't the same as the one according to doctor's order, which was caused by nurses. Medication error include wrong drug type, medication time, dose, administration route, patient, etc.	Drug name by doctor's order, wrong drug, wrong medication time, wrong dose, wrong administration route, wrong patients, wrong medication frequency, wrong infusion speed, wrong dosage, wrong drug concentration, drug administration when lack of doctor's order, implemented doctor's oral order when not a rescue, past-due drug, implemented stopped doctor's order, drug missing.	Systematic factors: number of patients the nurse taking care of, nurse's training of relative knowledge, lack of drug use warning in information system, wrong or unclear drug label, similar drug names, similar drug packaging, similar drug shapes, drug dispensing machine out of order, mobile nursing system out of order, unclear writing of requisition for drugs due to overmuch check, easily confused drug placed together with no electronic medicine cabinet.	Patient's factors	Medical staff factors: unclear writing, incomplete doctor's order, incomplete printing of doctor's order sheet, misheard when implemented doctor's oral order, misread order, misunderstood order, wrong administration, wrong dispensing, unable to use medication machines, order without double check, invalid medication information shift, expensive or poison anesthetic drug missing due to cabinet unlocked, drug out of date due to no timely check, wrong pasted drug label.	Environmental factors: easily confused drug placed together in electronic medicine cabinet, lack of warning sign for easily confused drug, drug missing as to drug and other things were put together.	Uncomfortable complain, drug reaction, rescue, disability or death, further treatment received in other medical organizations.
Accident	Unusual treatment; sudden, hard to guard against and harm to individual action, which happened during patient's treatment in hospital, e.g., scald, irritant drug extravasation, aspiration.	Place, accompanist, body disability, language expression difficulty, number of patients the nurse taking care of, nurse's training of relative knowledge, equipment out of order.	Events like burn, scald, drug extravasation/phlebotomosis, restraint accident, aspiration, blood transfusion error, electrical lesion, suicide/autolesion have their own event description and reason analysis.				Uncomfortable complain, skin injury, nerve injury, limbs ischemia and necrosis, fracture, asphyxia, infection, operation or rescue, disability or death, further treatment received in other medical organizations.

Table 3. Individual reporting content of nursing adverse event.

background, and chief medical diagnosis. (4) Brief description of the event. The individual reporting content of nursing adverse event is shown in Table 3.

4. Discussion

4.1. Representation of experts

The study invited experts who had worked for >10 years in clinical nursing, nursing administration, or nursing teaching research field. They were familiar with this study content and had gained in-depth knowledge of patient safety. All experts had a bachelor's or higher degree, intermediate or higher professional title, and >10-year working time. It could be seen that the representation of experts was fine.

4.2. Reliability of results

Items' adding or removing was according to scientific standard, and as the study was carried out on the basis of Swiss Cheese Model, it was reliable. First, initiative coefficients of experts were 100% in two-round consultation, which indicated that experts were interested and positive in this study. Second, the literature showed if authority coefficients were >0.7, the experts could be considered of high authority.¹³ Experts participated in this study all had authority coefficients which were >0.7. Third, it was shown that items retained should have a score >3.5.¹⁴ There were six items which did not have scores demanded in the first round, and none in the second, illustrating the high concentration of experts' suggestion. Fourth, the coordination coefficient in the first and second round was 0.543 and 0.629, respectively. Both coefficients were significantly different ($p < 0.01$). These coefficients demonstrated high coordination.

4.3. General reporting content of nursing adverse event

Compared with the content used now, time when event happened, was found and was reported was added. Literature indicated that the process of the adverse event "happen-be found-be reported" could demonstrate nurse's working attitude and busy level, normalization and complexity of reporting flow. These reflect systematic factors like human resource management, nurse training, and establishment of reporting flow as well. American Medical Management Committee emphasized that the key of medical adverse event is system.¹⁵ At the same time, attention from studies abroad had been paid to systematic factors in place of personal error¹⁶ and

patient safety could be achieved by the improvement of system.¹⁷ This point of view was in accordance with the idea of developing reporting content in this study, that is, preventing the happening of the similar event again from telling and completing nursing systematic weak links.

4.4. Individual reporting content of nursing adverse event

4.4.1. Individual reporting content of pressure sore

The reason analysis was detailed in this study. First, objective indicators were added, for example, if the patient had hypoproteinemia, the nurse needs to write down the number of his total plasma protein. Second, the further cause was searched. For example, if the patient's bed wasn't clean, it could be in relation to "no timely delivery to ward of clean sheet", "the patient's noncooperation for sheet renewal", "negligence of nurses". These specific reasons would belong to systematic factors like the process of clothes and sheet cleaning, patient factors like their cooperation and medical staff factors like nurse's working attitude. It was indicated that the setting of objective indicators could help to reduce the influence of reporting content truth caused by subjective assumption.¹⁸ Further and deep reason analysis may lead to come up with the discussion of different factors based on the Swiss Cheese Model. As a result, adjustment and improvement of these factors is the next step.

4.4.2. Individual reporting content of fall/falling from bed

First, based on literature review, drug medication was described more in details comparing to reporting content domestic and abroad.¹⁹⁻²² Descriptions were added like drug's name, type, dose, frequency, time between drug administration and falling happened. Second, some reasons were explored further. For example, the situation of nurse's training was divided into three conditions, namely, participating in training, not participating in training and no training. If one joined training but lacks of relative knowledge, it could be in relation to systematic factors like the setting of training content and form, medical staff factors like nurse's half-heartedness of receiving training. If there was training while one did not go in for it, it could relate to systematic factors like unable to attend due to lack of human resources, medical staff factors like nurse's learning attitude. If there was no training of relative knowledge, it may be in connection with systematic factors like leaders' indifference to training. Along with the promotion of non-punitive reporting culture in China,²³ the significance of reporting adverse event is to prevent and control,

especially lean attention on systematic safety. And this study did add analyzing personal error from the point of systematic factors.

4.4.3. Individual reporting content of unplanned extubation

Generally, reporting content abroad did not refer to the content of unplanned extubation, or sorted it into accident content.¹⁹⁻²² As a result, this event did not have its individual reporting content. In comparison with the content used now, specific situations of unplanned extubation were supplied, including air sac or water sac rupture, suture breakage, extubation while getting rid of restraint, extubation when patient's relatives did not understand, patient with cognitive impairment extubated himself, extubation when could not tolerant uncomfortable catheterization and catheters stretched. Literature indicated that there were various and complex situations of unplanned extubation.^{24,25} Meticulous situation reporting would be beneficial for analyzing from systematic factors like improving catheter quality, medical staff factors like offering patients and relatives health education and paying attention to patients with cognitive impairment.

4.4.4. Individual reporting content of medication error

Different from just describing medication error types in reporting content used now, this study listed reasons from systematic, personal, and environmental factors according to the Swiss Cheese Model. Some expressions were modified to correspond with Chinese mainland actual clinical situations. For example, "medication equipment" was altered as "injection pump and infusion pump"; "lack of electronic doctor's order screening and control system" was changed as "lack of drug use warning in information system". Establishment of reporting content should take nurses'

comprehension into account. Too abstract content may be difficult for nurses to understand, which influences the reality and completeness of reporting content.

4.4.5. Individual reporting content of accident

As definitions domestic and abroad of accident were different, these regions' reporting contents were of little comparability. However, when it came to specific event reporting content, the result of this study was in accordance with that abroad.¹⁹⁻²² And reason analysis of events like burn, scald, drug extravasation/phlebophlogosis, restraint accident, and aspiration were supplied based on the content used now.

5. Conclusions

Although the National Health Commission proposed to strengthen the reporting and management of medical adverse events,²⁶ the specific reporting content of common nursing adverse events has not been clearly stipulated. In this study, especially reason analysis parts of reporting content were established based on the Swiss Cheese Model and nursing adverse events' reporting content of hospital was developed. This study made up the drawback of lacking normalization in the content now and would play a role in the development of nursing adverse event report and feedback system. The next step is to test and revise this reporting content in clinical practice.

Ethical approval

Ethical issues are not involved in this article.

Conflicts of interest

All contributing authors declare no conflicts of interest.

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