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Effects of early warning interventions on the incidence of nursing interruptions and adverse nursing outcomes in China

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ABSTRACT Objective: The incidence of nursing interruptions is very high, with an occurrence of at least one event every 10 minutes. As nearly 90% of interruption incidents cause negative outcomes, there is a need to implement early warning interventions to reduce the incidence of nursing interruptions and negative nursing outcomes. This study aimed to examine the effects of early warning interventions on nurses to reduce the incidence of nursing interruptions and adverse nursing outcomes, compared with a historic control group. **Methods:** This was a quasi-experimental study, with outcome measures examined pre- and post-intervention. **Results:** A total of five hospital departments joined this study. After early warning interventions were implemented, the incidence of interruptions decreased significantly (P<0.001) and adverse nursing outcomes were also significantly reduced, from 79 to 41 (P<0.001). Additionally, nursing quality check scores increased significantly (P<0.001). **Implications for Practice:** The implementation of early warning interventions can reduce the incidence of nursing interruptions and negative nursing outcomes, and ultimately improve the quality of nursing care.

KEYWORDS: Nursing interruptions; Early warning intervention; Adverse nursing outcomes; Chinese nurses

INTRODUCTION

Nurses are the largest group of health care professionals worldwide, delivering nearly 80% of hands-on health care.(Mancuso and Davidson, 2020) Nurses are direct observers of patients and hands-on providers of clinical treatment. Interruptions are prevalent in nursing practice, making it difficult to complete a nursing intervention and leading to a break in workflow continuity. (Bertolazzi and Perroca, 2020) The American Institute of Medical Research reports that interruptions reduce nursing staff efficiency and seriously affect patient safety. (Page, 2004) Once an interruption event occurs, it could result in a prolonged hospital stay for the affected patient, as well as higher patient mortality rates. (Johnson et al., 2014) 'Nursing interruptions' refers to the interruption events encountered by nursing staff in the process of providing nursing care.

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Nursing staff are suddenly disturbed by external actions that delay their current caring activities and distract them from their current task.(Schroers, 2018) The incidence of nursing interruptions is very high, with an occurrence of at least one event every 10 minutes.(Monteiro et al., 2015; Schutijser et al., 2019; Katherine et al., 2018) Nearly 90% of interruption incidents cause negative outcomes, such as causing medical administration errors (MAEs), seriously affecting the quality of nursing care and threatening patient safety. (Monteiro et al., 2015; Raja et al., 2019) Due to the complex clinical environment and diverse patient conditions, it is very important to reduce the incidence of nursing interruptions. (Katherine et al., 2018; Myers and Parikh, 2019) Research reports show that 88.9% of nursing interruptions are negative. They include deferring a current nursing task, a temporary memory lapse, increased workload, and the occurrence of MAEs, which pose a serious threat to patient safety - indicating that most interruption events exert a negative impact on nursing outcomes.(Katherine et al., 2018)

Preventing interruption events is of great significance in order to reduce medical errors.[10-12] However, the incidence of nursing interruptions has increased in recent years. (Monteiro et al., 2015;

Schutijser et al., 2019) Clinical nurses are focusing more on the incidence and consequences of nursing interruptions on nursing outcomes. The existing literature also shows that nursing interruptions are an important factor leading to adverse nursing outcomes, (Mancuso and Davidson, 2020; Monteiro et al., 2015; Schutijser et al., 2019; Katherine et al., 2018; Raja et al., 2019); and that early warning interventions can effectively reduce the occurrence of nursing interruptions and adverse nursing outcomes. (Johnson et al., 2014; Zhao et al., 2019; Huang et al., 2015) Therefore, this study aimed to examine the effects of early warning interventions on nurses to reduce the incidence of nursing interruptions and adverse nursing outcomes, compared with a historic control group.

METHODS

This is a quasi-experimental study, with outcome measures examined pre- and post-intervention.

Study participants

Inclusion criteria were nurses working the day shift in the units included in the study. Nurses who worked the night shift were excluded, as this study collected daytime data weekdays from Monday to Friday. Sample size justification was based on similar interruption research: "To detect a 10% improvement, at a 5% significance level (β=0.8), it needs approximately 300 observations in the post-intervention evaluation.(Biron et al., 2009) This study was conducted in five hospital units for a period of three months, and each of the units that was studied was observed with 20 observations per month.

Interventions

Before implementing this early warning nursing intervention, the Nursing Quality and Safety Management Committee conducted a systematic and comprehensive education program across the hospital units. The flowchart of the early warning intervention is listed in Figure 1.

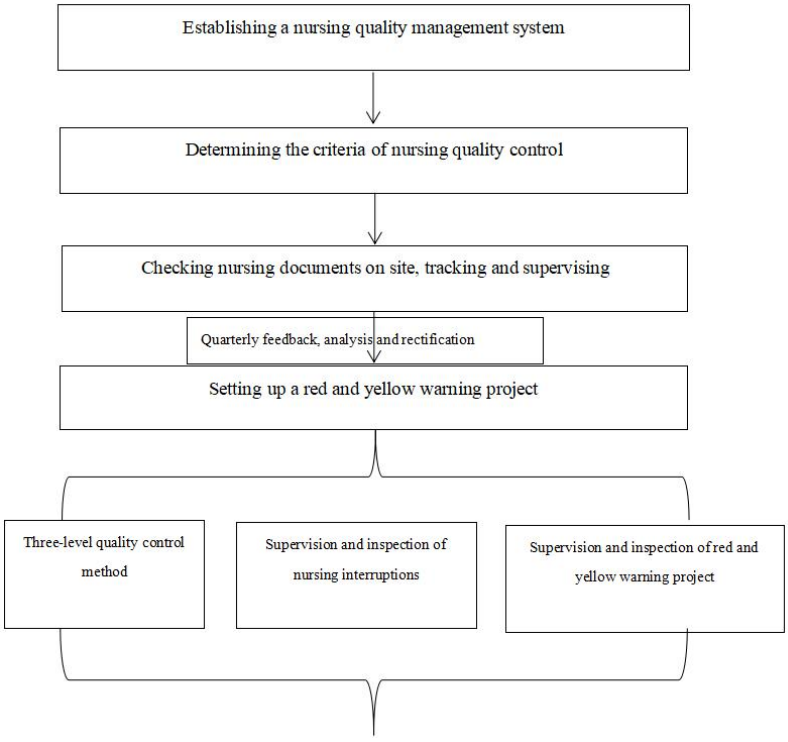

Figure 1. Flowchart of the implementation of early warning intervention

This early warning intervention was based on the three-level quality control method, with the addition of the identification, prevention and control of red and yellow early warning items. Meanwhile, a reward and punishment mechanism were established, linked to the nursing unit's comprehensive target assessment scores. Processing indicators affect the occurrence of nursing interruption events. The details of this early earning intervention are shown in Table 1.

Table 1 Three-level quality control method

	Level 1	Level 2	Level 3
Inspectors	Each unit has a quality control team: the unit Head Nurse acted as the team leader, and all nurses were involved	District quality control team: the district Head Nurse acted as the team leader, and all unit Head nurses were involved	Whole hospital quality control team included all members of the Nursing Quality and Safety Management Committee
Inspection frequency	Conducting spot checks every day, and making immediate corrections	Rectification and follow-up were carried out at any time for problems in the nursing units' tertiary quality inspection.	The quality control, safety and continuous improvement team organized a quarterly comprehensive inspection, discussion and analysis, and supervised rectification.
Inspecting content	General inspections: ward management, disinfection and isolation, inpatient management, health education, and patient satisfaction; special care unit supervision: management of critically ill and special patients; patient pipeline management, medication safety, and core regulation implementation.	Special supervision: adverse event tracking, nursing risk assessment, patient identification, pressure ulcers, fall prevention, and patient transfer; supervision of key links: high-risk nurses, high-risk patients, high-risk time periods, high-risk links.	According to the quality nursing service evaluation rules and the relevant provisions of the tertiary general hospital grade review, comprehensive supervision and inspection of all units in the entire hospital was conducted regularly; checking and spot checking key issues (red and yellow warnings) quarterly; each special nursing work was monitored by the special nursing management team according to quality standards.

Based on existing nursing interruption studies(Schroers, 2018; Monteiro et al., 2015; Katherine et al., 2018)and our previous research (Zhao et al., 2019), we found that hospital working units - such as pediatric, respiratory and obstetric wards; intensive care units (ICU) and emergency departments - have the highest incidence of nursing interruptions. This study built up key early warning intervention lists, taking nursing interruption type and outcomes into account (Table 2).

Table 2 Early warning intervention lists

Red warning list	Yellow warning list
1. Rescue medicines and rescue vehicles not replenished in time or in a standby state	1. Bedside card does not match the patient's situation
2. Drug allergy not labeled	2. Unlabeled bedside isolation
3. Threshold values indicating critical care not dealt with in time	3. Lack of close monitoring of special medical treatment
4. Identity verification not performed correctly or not performed at all	4. Oral medication not given to patients in a timely manner
5. No safety protection measures for critically ill or unconscious patients	5. Fall prevention measures for patients not in place

Red early warning lists are severe events that may endanger patient safety. Yellow early warning lists are less severe events, but may cause changes in patients' vital signs, affect patient rehabilitation or violate hospital regulations. Intervention providers include nurses-in-charge, unit head nurses, and nursing quality control specialists. Nurses-in-charge monitor on a daily, head nurses monitor on a weekly, and nursing quality control specialists monitor on a monthly basis.

Study measures

Baseline evaluations were recorded at the end of March 2019, followed by a six-month intervention (from April to September, 2019). We reviewed the outcome evaluations at the end of December 2019.

***Interruption Observation Sheet (IOS)*:** An interruption was defined as "nurses ceasing a current task to respond to an external stimulus.(Westbrook et al., 2017) This sheet was used to collect key information on the incidence and outcomes of interruptions per observation hour. The IOS was collected twice, by a research nurse who did not work in the wards and performed the observations. The nurse conducted observations weekdays between 8 a.m. and 6p.m., nurses on the study wards were observed directly and the research nurse performed the observation directly. The IOS was a validated tool and supported by our previously published research.(Robert, 2019; Xie et al., 2016) In this study, reliability analysis of the IOS internal consistency by Cronbach's alpha was 0.74.

Nursing Outcome Sheet (NOS): The NOS was used to recorded adverse nursing outcomes. This sheet was classified into two options: Yes, meaning 'with adverse nursing outcomes' and No, meaning 'without adverse nursing outcomes'. This sheet was completed by the Nursing Quality Control Specialist, based on the inspection documents, on-site inspection and follow-up supervision results of each supervision team. The NOS was pilot tested before being applied in this study by five head nurses, and Cohen's kappa scores show that the NOS has good inter-rater reliability.

Nursing Quality Check Index (NQCI): This NQCI used the items listed in Table 2, with a total of 10 items. The full score of each item was 10, with a total of score of 100. Higher scores indicate better nursing quality. The NQCI was pilot tested before being applied into this study by five head nurses, and the Intraclass Correlation Coefficients show that the NQCI has good inter-rater reliability.

Data collection and statistical analyses

Data were collected from January to December 2019. This study obtained ethical approval from The Third Affiliated Hospital of Guangzhou Medical University (No. ELKS2019D112H). Descriptive statistics and comparative analyses were performed by IBM SPSS Statistics 25. The threshold for statistical significance was set at $P < 0.05$.

RESULTS

A total of five hospital departments joined this study. These five departments (Pediatric Ward, Respiratory Ward, Obstetric Ward, ICU and Emergency Department) were observed for a year. The first annual quarter (January to March, 2019) was taken as the baseline observation period, six months (April to September, 2019) as the intervention period, and the last quarter (October to December, 2019) as the post-intervention observation period.

Key study outcomes are listed in Table 3. The incidence of interruptions decreased significantly ($P< 0.001$). The total number of nursing interruptions decreased from 216 to 197, and the number of negative interruption outcomes was also significantly reduced, from 42 to 19. After early warning interventions, adverse nursing outcomes were also significantly reduced, from 79 to 41 ($P<0.001$). Nursing quality check scores increased significantly ($P<0.001$).

Table 3 Comparison of key study outcome mean scores

Outcomes	Mean (SD) / n (N)*		t/Chi-square	*P*
	Baseline	Post-intervention		
Interruption incidence	1.92 (0.37)	1.71 (0.33)	7.43	< .001
Nursing quality check score	87.01 (2.42)	97.58 (2.29)	14.27	< .001
Negative interruption outcomes/total number of interruptions	42 (216)	19 (197)	6.89	.003
Adverse nursing outcomes/total number of adverse events	79 (359)	41 (302)	13.15	< .001

Notes: n (N)*, the total number of negative interruption outcomes or adverse nursing events occurred in the studied units; N, the total number of negative interruption outcomes or adverse nursing events occurred across all hospital units.

DISCUSSION

Consistent with previous nursing interruption studies,(Johnson et al., 2014; Zhao et al., 2019; Yang et al., 2010; Sasangohar et al., 2015) the implementation of standardized early warning interventions can reduce nursing interruptions and negative nursing outcomes, and continuously improve nursing quality. This study found that the implementation of a "red and yellow early warning intervention" is well worth promoting and applying in other hospital settings. This early warning intervention project constructed a standardized early warning model, created an early warning culture, and raised awareness of the importance of early warning among nursing staff. Realizing that potential risks can be prevented through early warning can lead to a stronger safety focus in nursing, helping prevent the risks involved in nursing care and maintaining patient safety.(Li et al., 2012; Cintia and Machado, 2015) Previous studies have indicated that nursing interruptions are a key factor leading to the occurrence of adverse nursing events.(Williams et al., 2014) Werner and Holden pointed out that reducing nursing interruptions to prevent adverse nursing events has far-reaching implications.(Werner and Holden, 2015) Thoroughly discussing the interruption sources, establishing the interruption mechanism and summarizing lessons learned can effectively prevent the recurrence of nursing interruptions,(Werner and Holden, 2015) and reduce their adverse impacts on the quality of nursing care.(Craker et al., 2017) Nursing interruptions can be seen as essential to nursing care quality, and play an important role in optimizing nursing outcome indicators.(Craker et al., 2017)

In addition, early warning interventions should call for medical doctors, health care assistants and patients alike to be involved, so that all stakeholders participate in the process of improving the quality of patient care. In future investigations, we will be able to focus more on the sources, types, outcomes and influencing factors in various nursing interruption events. Therefore, future research should continuously strengthen the implementation of standardized early warnings throughout the entire cycle, effectively reducing nursing interruptions, optimizing outcome indicators and continuously improving nursing quality.

Finally, this study has two limitations. On the one hand, as the research took place at three hospitals in South China, the study setting may not represent all hospitals across China, and the generalizability of the study findings may be limited. On the other hand, nursing interruptions may contribute to both negative and positive outcomes, but this study only reported the negative outcomes. Therefore, future research should observe both the negative and positive outcomes of interruptions experienced by Chinese nurses.

CONCLUSION

After implementing the red and yellow early warning interventions, the incidence of nursing interruptions, negative interruption outcomes and other adverse nursing outcomes were significantly reduced, ultimately improving the quality of nursing care.

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