Development and Implementation of a Clinical Nursing Practice Guideline for Prevention and Management of Increased Intracranial Pressure in Hemorrhagic Stroke Patients

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Abstract

Background: Hemorrhagic stroke is a serious condition that leads to high morbidity and mortality rates, particularly within the first 30 days following the stroke. One serious complication is increased intracranial pressure (IICP), which worsens neurological symptoms and can result in death or disability.

Purposes: To develop and implement a clinical nursing practice guideline (CNPG) for prevention and management of IICP in hemorrhagic stroke patients.

Methods: This study had two phases: (1) Evidence trigger and support, identifying clinical problems and gathering empirical evidence, and (2) Evidence-observed, where a CNPG was developed and implemented. The CNPG was based on the Nursing Role Effectiveness Model and Soukup's Nursing Practice Development Model, covering preoperative and postoperative care and key nursing activities such as assessment, prevention, and management. The study assessed the CNPG's impact on nurses' knowledge, practices, and implementation feasibility. Nineteen registered nurses from the Surgical Intensive Care Unit were included and analyzed using descriptive statistics, interquartile range, and the Wilcoxon signed-rank test.

Results: The findings showed a significant improvement in nurses' mean knowledge scores after implementing the nursing guideline for preventing IICP in hemorrhagic stroke patients ($p < 0.000$). The overall mean knowledge score was high ($\bar{X} = 23.11$, SD = 2.54, Mdn = 23, IQR = 5). Additionally, the total mean nursing practice score ($\bar{X} = 122.53$, SD = 17.80) and overall mean perceived implementation feasibility score were both high ($\bar{X} = 4.68$, SD = .35).

Conclusions: The findings suggest that integrating nursing practice guidelines and providing training to enhance nurses' knowledge significantly contribute to positive outcomes in both structure and process. Regarding structure, nurses demonstrated increased knowledge and proficiency in nursing practices. Regarding process outcomes, evidence-based guidelines were effectively utilized, paving the way for practical application in future nursing practice.

Keywords

hemorrhagic stroke, intracranial pressure, intracranial hypertension, practice guideline, feasibility study

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Introduction

Hemorrhagic stroke is a type of cerebrovascular accident that carries a substantial burden of morbidity and mortality (Feigin et al., 2017). Globally, it is estimated that out of the 101 million stroke patients, 21 million suffer from intracerebral hemorrhage (ICH) and 8.4 million suffer from subarachnoid hemorrhage (SAH). Annually, there are over 3.4 million new cases of ICH and 1.2 million new cases of SAH. These hemorrhagic strokes contribute to more than

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3.3 million deaths per year and result in disability for over 6.9 million individuals (Feigin et al., 2022). Consequently, the associated hospital treatment costs are significant (Ashkan et al., 2020).

In the implementation setting, a private tertiary-level hospital, hemorrhagic stroke poses a significant public health challenge. Data from 2017 to 2022 reveal an increase in the incidence of stroke from 278.49 to 330.72 per 100,000 population, with hemorrhagic stroke accounting for most cases from 79.27% to 88.38%. Furthermore, the mortality rate associated with hemorrhagic stroke has shown a slight increase from 26.88% to 27.58% (Tiamkao, 2022), particularly within the initial 30 days following the occurrence of the stroke event (Duangkaew & Jumpamool, 2018). From 2018 to 2020, the data of one tertiary private hospital revealed the highest number of admissions for hemorrhagic stroke patients with subdural hematoma, intracerebral hemorrhage (ICH), and SAH, with 55, 34, and 30 cases, respectively. Most of these patients were over the age of 70 and increased mortality rates from 2.30%, 3.10%, and 6.25%, respectively. Within the initial 1–24 h following a hemorrhagic stroke, hematoma formation may occur, while within 24–48 h, swelling of the surrounding brain tissue may manifest. Such swelling has the potential to disrupt both venous and arterial circulation, as well as impede the flow of cerebrospinal fluid. The compressed brain tissue faces a heightened risk of developing increased intracranial pressure (IICP), which occurs in over 70% of cases. Increased intracranial pressure is a critical complication worsening neurological symptoms and contributing significantly to mortality and disability (Prachuablarp, 2018; Shafi et al., 2008), often manifesting within 6–12 h before surgery and peaking six hours post-procedure (Carney et al., 2017). The characteristics and severity of IICP may vary based on the pathology's location, hematoma size, and onset time. Hence, prompt management of hemorrhagic stroke within the first 12 h of symptom onset is vital for recovery (Ashkan et al., 2020; Feigin et al., 2022; Pongsavang et al., 2020; Pukkungvayung & Sittipakorn, 2022).

Review of Literature

Despite numerous guidelines, research, and academic articles on managing patients with IICP (Greenberg et al., 2022; Hussein et al., 2017; Prachuablarp, 2018), there's a lack of specific nursing practice guidelines for preventing IICP in hemorrhagic stroke patients, particularly in the first 72 h of care. A comprehensive literature review reveals a scarcity of international studies, with only one conducted in Thailand (Pongsavang et al., 2020). This clinical nursing practice guideline (CNPG) for patients with acute cerebral hemorrhage significantly reduced intensive care unit (ICU) treatment duration ($p < 0.05$) and received high satisfaction from nurses ($p < 0.05$). Complication rates, including IICP,

cerebral edema, ventilator-associated pneumonia, and aspiration, dropped from 34.6% to 23.1%. Existing literature on hemorrhagic stroke and severe head injury treatment, involving medication, surgery, or both, shows consistent assessment and prevention strategies for IICP. These include using the Glasgow Coma Score (GCS) for evaluation, along with airway management, blood pressure control, head elevation, fluid administration, temperature regulation, ventricular drainage, and craniotomy (Carney et al., 2017; Greenberg et al., 2022; Hussein et al., 2017; Pukkungvayung & Sittipakorn, 2022).

A literature review highlights varied uses of the Modified Early Warning Score (MEWS) in hospitals, including sepsis assessment (Tummikakul, 2020), cardiac catheterization (Chuaychang, 2018), early deterioration detection (Kaewpetch, 2021; Pin-noi et al., 2021), unplanned ICU admissions (Ritklar, 2016), emergency patient monitoring (Phumboonchu, 2019), and SAH (Leksomboonsuk, 2021). Hester et al. (2021) found that MEWS-SRS is associated with higher in-hospital mortality in neurocritically ill patients but is unreliable for detecting infection or sepsis, with a 6% predictive value, instead triggering evaluations for neurologic worsening.

In the implementation setting, hemorrhagic stroke patients were assessed using the GCS, while early signs of severe deterioration were detected through the MEWS. It is used to assess all patients in the ICU upon admission and before discharge, not for ongoing neurological monitoring. In general wards, MEWS helps detect early signs of deterioration and supports nurses in monitoring, recognizing critical symptoms, and responding to patient needs. Symptoms linked to IICP were listed to assess included confusion, restlessness, drowsiness, blurred vision, speech difficulties, disorientation, unequal pupil size, reduced light response, worsening headaches, decreased consciousness, and increased limb weakness. Previously, standardized nursing guidelines for preventing IICP in hemorrhagic stroke patients were limited. Consequently, patient assessment relied on individual nurse experiences, possibly delaying abnormal symptom detection and treatment initiation. In response to enhance the quality of nursing care, the researcher developed evidence-based CNPG for preventing IICP in patients with hemorrhagic stroke. These guidelines were created through the synthesis and analysis of empirical evidence, diligently categorized, and compiled for practical application within the unit.

These guidelines were developed using the Nursing Role Effectiveness Model (NREM) (Irvine et al., 1998) and Soukup's evidence-based practice model (2000) to ensure standardized care. Nursing Role Effectiveness Model focuses on nurses' knowledge (structure), guidelines for preventing IICP in hemorrhagic stroke (process), and clinical control (outcome). The guidelines address pre- and postoperative care, including patient preparation, IICP assessment, prevention, and treatment, with nurse training enhancing

both knowledge and practice. The model has two phases: (1) identifying clinical problems and searching for evidence support and (2) developing guidelines and implementing them. The study aimed to create and evaluate the CNPG, assess nurses' knowledge and practices, measure patient outcomes postimplementation, and determine the feasibility of CNPG utilization—the conceptual framework for this study is shown in Figure 1.

Methods

By its nature, this study employed a quantitative approach, consistent with the research objective, focused on systematically developing, implementing, and evaluating the feasibility of a CNPG through structured phases. This approach emphasizes data collection and analysis to ensure evidence-based conclusions about the guideline's applicability in clinical settings. The study was conducted in distinct phases; it commenced with identifying key issues and searching for evidence, followed by developing and implementing the CNPG. In Phase 1, the sample comprised evidence-based documents analyzed to support the development of the CNPG, while Phase 2 involved nurses as participants to evaluate its feasibility in practice. Data collection began subsequent to the CNPG's implementation, with each phase detailed as follows.

Design

This implementation research aims to develop and evaluate the feasibility of a CNPG for the prevention and management of IICP in patients with hemorrhagic stroke. The study adhered to the AGREE reporting checklist for reporting clinical practice guidelines. It was conducted between June and July 2023, with approval from the Human Research Ethics.

Phase 1: The Evidence trigger and evidence support phase involves identifying clinical problems and searching for evidence related to the problems.

Population and sample: Nursing-related electronic databases, including PubMed, Ovid, ClinicalKey for Nursing, and ThaiJo. The Evidence-based research related to the clinical issues being addressed. Studies from the past 10 years (2012–2022) in Thai and English were analyzed and synthesized to develop effective practice guidelines. Keywords for the search are based on the PICO framework.

Inclusion criteria: The evidence-based documents related to hemorrhagic stroke and brain injury.

Exclusion criteria consisted of (1) duplicate evidence-based documents, (2) those with inaccessible full-text content, (3) those focusing on ischemic stroke, pediatric hemorrhagic stroke, and animal studies, and (4) those not aligned with the research objectives.

The keywords for the search were determined based on the PICO framework, with key terms including P: Brain hemorrhage, Hemorrhagic stroke, Intracranial pressure, I:

Clinical Nursing Practices Guideline, Journal, Academic articles & Research articles, and O: Knowledge, Practice, Feasibility.

The quality of the empirical evidence and the search result is presented in the supplement.

Phase 2: The evidence-observed phase involved developing and implementing CNPG within the unit.

Sample and Setting

In feasibility studies, Moore et al. (2011) argue that no formal sample size justification is required due to the exploratory nature of such studies. Browne (1995) suggests a minimum of 30 participants to estimate a parameter accurately, while Julious (2005) recommends a minimum of 12 participants per group for feasible and precise estimation of mean and variance. Accordingly, this study seeks to assess the feasibility of the newly developed CNPG within a specific context. Hence, all 19 nurses who work at the Surgical ICU and Surgical Ward at the 244-bed private tertiary-level hospital were invited to the study.

The inclusion criteria included nurses who worked during the study period and were willing to participate. Nurses on sick, maternity, or study leave during this time were excluded from the study.

Research Instruments

The research instruments employed in this phase were divided into two categories: instruments for research implementation and data collection.
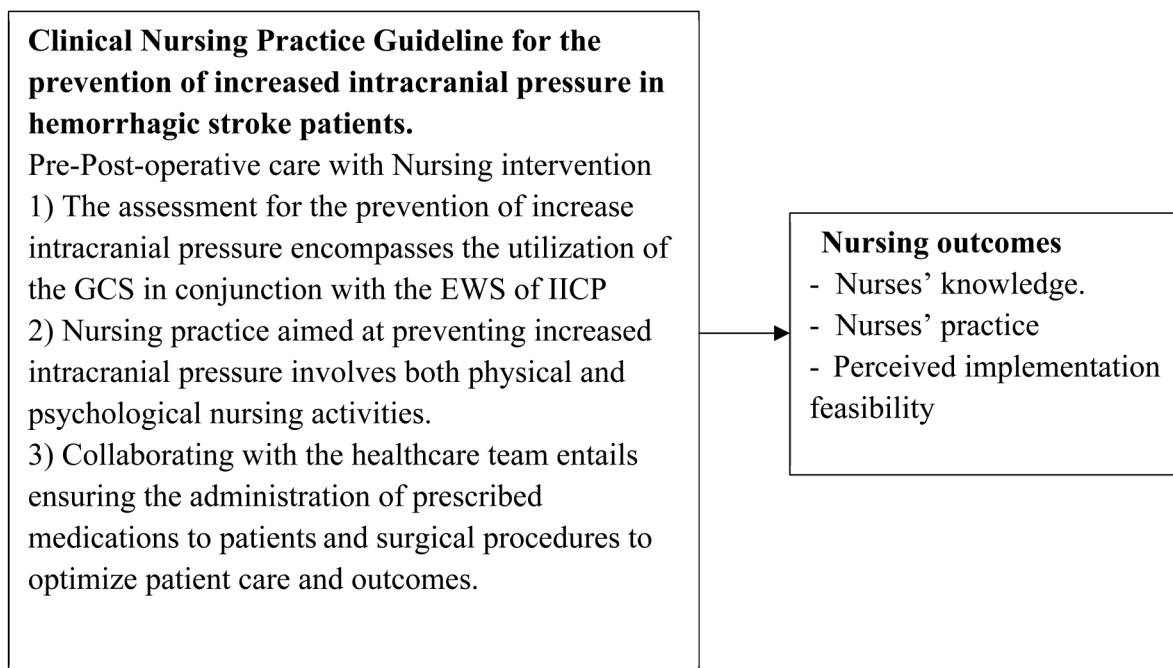
Implementation instruments: The primary research instrument was a developed CNPG for preventing IICP in hemorrhagic stroke patients. It covered two stages of care and three nursing practice areas: assessment, prevention, and management, ensuring proper medication, and surgical treatment.

- Assessment of IICP: involves using the GCS alongside Early Warning Signs of IICP.
- Prevention of IICP: categorized into two aspects, including physical care and psychological care. The physical care was grouped according to body systems, including the nervous, respiratory, cardiovascular, circulatory, digestive, hematology, endocrine, renal, and immune systems.
- Management for patients receiving medication and surgical treatment: includes ventricular and lumbar drainage catheter insertion for cerebrospinal fluid drainage, craniotomy, and preoperative and postoperative care.

Data collection instruments: The study used six data collection instruments, which were reviewed for validity and accuracy by a neurosurgeon, a clinical nurse specialist in neurosurgery, and a nursing lecturer experienced with hemorrhagic stroke patients. The instruments were revised based on their recommendations.

Clinical Nursing Practice Guideline for the prevention of increased intracranial pressure in hemorrhagic stroke patients.
Pre-Post-operative care with Nursing intervention
1) The assessment for the prevention of increase intracranial pressure encompasses the utilization of the GCS in conjunction with the EWS of IICP
2) Nursing practice aimed at preventing increased intracranial pressure involves both physical and psychological nursing activities.
3) Collaborating with the healthcare team entails ensuring the administration of prescribed medications to patients and surgical procedures to optimize patient care and outcomes.

Nursing outcomes
- Nurses' knowledge.
- Nurses' practice
- Perceived implementation feasibility

Figure 1. Conceptual framework of the study.

1. Nurse Information Record Forms: The five-item form with open-ended and closed-ended questions was used to collect data related to age, educational level, duration of work experience, and training related to caring for patients with cerebral nervous system disorders.
2. Patient Information Record Forms: This form was used by the researchers to record patient information who received nursing care with CNPG for preventing IICP in hemorrhagic stroke patients
3. Nurses' knowledge for preventing IICP questionnaire: the 30-item four-choice questionnaire, developed by researchers, assessed nurses' knowledge of IICP prevention in hemorrhagic stroke patients. Correct answers scored 1 point, with a total possible score of 0–30. It covered three sections: (1) Pathophysiology (eight items), (2) Nursing Aspects (17 items, divided into assessment and preventive care), and (3) Treatment (five items). Higher scores indicated greater knowledge. The questionnaire had a content validity index (CVI) of 0.91 and reliability (KR20) of 1.0 and 0.99. Post-study reliability with 19 nurses showed KR20 values of 0.80 and 0.81.
4. Nursing practice for preventing IICP questionnaire: the 34-item questionnaire, adapted from Chunbang et al. (2013), was modified to fit the CNPG context. It used a 4-point Likert scale (1 = never, 4 = always) with a score range of 34–136. If a situation was not applicable, those items did not be calculated. The questionnaire had two sections: (1) IICP symptom assessment (14 items, score range 14–56) and (2) nursing care for IICP

prevention (20 items, score range 20–80). The CVI was 0.90, and Cronbach's alpha for reliability was 0.96.
5. Nurses' perceived feasibility of implementing the CNPG for preventing IICP questionnaire: the 10-item questionnaire based on Bowen et al. (2009) used a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). It included eight positive and two negative questions, with reversed scoring for negative items. The questionnaire covered five aspects: acceptability (two items), demand (two items), implementation (three items), practicality (two items), and expansion (one item). Higher scores indicated greater feasibility. The CVI was 1.0, and Cronbach's alpha was 0.85.
6. The observational checklist based on the developed CNPG: recorded whether nursing practices for preventing IICP in hemorrhagic stroke patients were performed correctly, incorrectly, or were not applicable. It ensured clinical control and had a CVI of 0.82.

Data Collection

1. After receiving ethics approval, the CNPG was piloted with eight nurses in a similar sample and setting.
2. Data collection commenced after receiving approval from the hospital Director. The researcher introduced the CNPG to key personnel, including the Director of Nursing, the Head of the Surgical Department, and the Head of the Ward, advocating for its adoption to enhance care quality and nursing skills.

3. Meeting with Care Team: A meeting was held with the neurological patient care team, including Neurosurgeons, Nurses from the Surgical ICU, and Nurses from the Surgical Ward. The researcher explained the CNPG, highlighting the importance of assessing and preventing IICP. Feedback was gathered from both medical and nursing teams.
4. Training Sessions: Comprehensive training sessions were conducted for nurses who consented to the study in the Surgical ICU and Surgical Ward. The training covered pathophysiology, nursing activities, and treatment knowledge, specifically on IICP assessment and prevention methods.
5. Monitoring and Support: Continuous monitoring and evaluation of nursing practice skills were carried out. Support was provided for any difficulties encountered during IICP assessment and prevention.
6. Posttraining Evaluation: After completing the training, nurses were evaluated on changes in their knowledge, perceptions of the feasibility and complexity of implementing the guideline, and challenges faced during implementation

The process of developing and implementing nursing practice guidelines for the prevention of intracranial pressure in hemorrhagic stroke patients was summarized, as shown in Supplement 2.

Table 1. Demographic Characteristics of the Participants (N = 19).

General data	N	percent
Gender		
Female	19	100
Age Mean = 35.16; SD = 10.79; Min = 22; Max = 54		
Less than 25	4	26
25–34	7	32
35–44	3	16
45–54	5	26.
Level of education		
Bachelor's degree	19	100
Duration of care for hemorrhagic stroke patients. Mean = 11.89; SD = 10.41; Min = 1; Max = 30		
Less than 3 years	6	32
3–5 years	1	5
6–10 years	3	16
More than 10 years	9	47
Neurological training experience	11	58
Type of training*		
Neurological training for 4 months	5	26
Neurological training for 30 days	1	5
Neurological training for 7–21 days	4	21
Specialized training for cardiovascular and thoracic patients	9	47
Specialized critical care specialist training	2	11

*One nurse can undergo training multiple times.

Data Analysis

Nurses' personal data, knowledge, practices, perceived feasibility of implementing CNPG, and observations of nursing practices for preventing IICP in hemorrhagic stroke patients were analyzed using descriptive statistics. The Wilcoxon signed-rank test was used to compare knowledge before and after implementing the CNPG.

Ethical Considerations

This study was approved by the Human Research Ethics Committee of the Faculty of Medicine Ramathibodi Hospital, Mahidol University. (MURA 2023/40). Participants were informed about the research objectives and procedures and provided written consent. They were assured of their right to withdraw without any impact on their work performance. Confidentiality was maintained by replacing participant names with codes.

Results

Participants' Characteristics

All of participants were female with bachelor's degree (100%), have the mean age of 35.16 (SD = 10.79) years. The detail of characteristics is seen in Table 1.

Nurses' Knowledge of Preventing IICP in Hemorrhagic Stroke Patients

The knowledge was assessed before and after receiving education using the Wilcoxon signed-rank test, as the knowledge scores were not normally distributed, and the sample size of 19 was considered small. Results revealed a Z-value of −3.827 and a p-value of .000 ($p < .05$), indicating a statistically significant increase in the nurses' knowledge at a high level following the education on the nursing practice guideline. The knowledge after utilizing the guideline was high overall ($\bar{X} = 23.11$, SD = 2.54, Mdn = 23, IQR = 5), and dimensionally across all aspects (Tables 2 and 3).

Nursing Practices After Utilizing the CNPG for Preventing IICP in Hemorrhagic Stroke Patients

The overall nursing practices after utilizing the CNPG for preventing IICP in hemorrhagic stroke patients achieved a mean score of 122.53 (SD = 17.80), with high dimensional scores across all aspects (Table 4).

Perceived Feasibility of Implementing the CNPG for Preventing IICP in Hemorrhagic Stroke Patients

The nurses' perceived feasibility of implementing the CNPG for preventing IICP in hemorrhagic stroke patients

Table 2. Nurses' Knowledge Levels Before and After Implementing Nursing Practices for Preventing IICP in Hemorrhagic Stroke Patients (N = 19).

Knowledge	Educational formats	Total number (N)	Average rank value mean rank	Rank sum (sum of rank)	Z	p value
Before educating	Negative rank	0[a]	.00	.00	−3.827[b]	0.000
After educating	Positive rank	19[b]	10.00	190.00		
	Ties	0[c]				
	Total	19				

IICP = increased intracranial pressure.
[a]Posttest score < Pretest score.
[b]Posttest score > Pretest score.
[c]Posttest score = Pretest score.
P < 0.05 statistically significant.

Table 3. Mean, Standard Deviation, Median, and Interquartile Range (IQR) Knowledge Scores for the Prevention of IICP in Hemorrhagic Stroke Patients, Both Overall and Dimensionally (N = 19).

Assessing individual knowledge of IICP	(Min-Max) score	(M ± SD) score	Mdn	IQR	Knowledge level
Pathophysiological aspects	5–7	5.84 ± .83	6	2	High
Assessing signs and symptoms	3–7	5.42 ± 1.02	5	2	High
Providing preventive nursing care	5–9	7.47 ± 1.02	8	2	High
Treatment	3–5	4.37 ± .68	4	1	High
Assessing overall prevention knowledge	17–26	23.11 ± 2.54	23	5	High

IICP = increased intracranial pressure.

Table 4. Mean, Standard Deviation, and Nursing Practice Level Scores After Implementing Nursing Practices for Preventing IICP in Hemorrhagic Stroke Patients (N = 19).

Nursing practices for preventing IICP	(Min-Max) score	(M ± SD) score	Nursing practice level
Assessment of signs and symptoms aspects	24–56	52.26 ± 1.81	High
Implementing preventive nursing care	42–80	70.26 ± 2.54	High
Assessing overall prevention knowledge	66–136	122.53 ± 17.80	High

IICP = increased intracranial pressure.

was assessed across five domains (i.e., acceptability, demand, implementation, practicality, and expansion) in the Surgical ICU and Surgical Ward, with each domain scored on a 5-point scale. The overall perceived feasibility was high, with a minimum score of 3.80, a maximum score of 5.00, and a mean score of 4.68 (SD = 0.354), as shown in Table 5.

When asked about potential modifications or further development of the guideline, responses were provided by 14 out of 19 nurses (73.68%) who had used the guideline. Five nurses expressed that the guidelines were clear and suitable for future use. One nurse mentioned that the guideline was difficult to read. Three nurses recommended the creation of nursing documentation and a bedside knowledge review chart, while one nurse suggested reformatting the guideline with concise headings to facilitate assessment. Six nurses proposed the implementation of the guideline organization-wide to foster a unified approach and enhance staff

knowledge and confidence. One nurse recommended evaluating the implementation of the guideline and monitoring outcomes every six months and revising it as new knowledge is acquired. Lastly, three nurses commented on the cost-effectiveness of the guideline.

Observation of Nursing Practices for Preventing IICP in Hemorrhagic Stroke Patients

During the observational assessment of nursing practices, the researchers observed 19 nurse participants applying the nursing practice guideline while caring for eight patients with intracranial hemorrhage to ensure clinical control for patients. Most of the nurses correctly performed nursing activities related to the topic of nursing practices for assessment per the guideline recommendations. However, one nurse incorrectly assessed and monitored for ventriculostomy-associated

Table 5. Mean and Standard Deviation of the Feasibility Level of Nurses' Perception Regarding the Implementing of Nursing Practices to Prevent Intracranial Pressure (N = 19).

Content	Recognizing the feasibility of implementing the practice			
	Min-Max	M	SD	Feasibility level
1. The content of nursing practice guidelines for the prevention of increased intracranial pressure is easy to understand, enabling nursing care to be provided immediately according to this practice. (Implementation)	3–5	4.58	.61	High
2. Nursing guidelines for the prevention of increased intracranial pressure are practical, suitable for the situation, and aligned with the organization's culture. (Demand)	4–5	4.79	.42	High
3. Nursing guidelines for the prevention of increased intracranial pressure may offer less benefits to agencies or organizations. (Demand)	2–5	4.79	.71	High
4. Nursing guidelines for the prevention of increased intracranial pressure recommend continuous application, even after the study concludes. (Acceptability)	4–5	4.74	.45	High
5. Nurses find satisfaction in utilizing nursing practices guidelines to prevent increased intracranial pressure. (Acceptability)	4–5	4.68	.48	High
6. This guideline provides nurses with guidance for managing increased intracranial pressure and enables them to assess and prevent it. (Implementation)	3–5	4.63	.60	High
7. The use of these guidelines hinders adherence to nursing practices aimed at preventing intracranial pressure. (Implementation)	3–5	4.79	.54	High
8. You can learn and adhere to guidelines to prevent increased intracranial pressure. (Practicality)	4–5	4.84	.38	High
9. Nursing practices aimed at preventing increased intracranial pressure enable patients to receive quicker responses to reporting and treatment. (Practicality)	4–5	4.74	.45	High
10. Nursing practices aimed at preventing increased intracranial pressure can be implemented in other agencies or hospitals. (Expansion)	3–5	4.26	.73	High
Total	3.80–5.00	4.68	.35	High

infection (VAI) in a patient with an indwelling external ventricular drain (EVD), detailed information can be found in Supplement 1.

During observations on detect and management of actual events, the nurse participants applied the nursing practice guideline in the care of eight patients with intracranial hemorrhage. Most of them performed the recommended practices correctly. However, the assessment of decreased level of consciousness using GCS was performed incorrectly by two nurses, detailed information can be found in Supplement 2.

On routine nursing care activities for patients, 19 participants applied the guideline in the care of eight patients. Most of them performed correctly. However, three failed at positioning the head, neck, and body in a neutral position, detailed information can be found in Supplement 3.

Discussion

This study demonstrates a process of developing and implementing the CNPG for Preventing IICP in Hemorrhagic Stroke Patients. When nurses acquired knowledge and utilized the standardized nursing practice guideline, it yielded positive outcomes, including increased nursing knowledge and confidence in performing nursing practices to ensure patient safety. Since the patient outcomes were not assessed in this study, further research is needed to evaluate these outcomes.

The CNPG for the Prevention of IICP in Hemorrhagic Stroke Patients

The CNPG was developed using the NREM (Irvine et al., 1998) and Soukup's (2000) Nursing Practice Development Model as its conceptual framework. The evidence was systematically selected with quality evaluation. It encompasses preoperative care, postoperative care, and various nursing activities, including assessment, prevention, and management. The healthcare team was involved in the development process. Ensuring the CNPG was well developed for further testing and use in a clinical setting.

Level of Knowledge in Preventing IICP in Hemorrhagic Stroke Patients

The participants involved in caring for hemorrhagic stroke patients and following the guidelines had an average age of 35 years. The majority fell into the 25–34 age group. All participants had prior experience in caring for hemorrhagic stroke patients. When nurses receive education and implement the nursing practice guideline, their understanding and confidence in patient care increase, consistent with previous studies. Furthermore, the findings of this study showed a statistically significant difference in knowledge scores after using the guideline to prevent IICP in hemorrhagic stroke

patients. These knowledge scores were higher after utilizing the CNPG. The dimensional and overall scores were at a high level, meeting the requirements of the study and aligning with a study by Phunawakul et al. (2017) on developing a CNPG for patients with traumatic brain injuries undergoing neurosurgery. In that study, 46 registered nurses achieved higher mean knowledge scores after training (Phunawakul et al., 2017). Having a strong knowledge leads to positive outcomes such as improved understanding, confidence, and skills in nursing practice (Dilorio & Price, 2001). Additional training allows nurses to acquire new knowledge, which combined with their existing tacit knowledge gained through real-world experience, further enhances their nursing abilities. Nursing competence can be developed through learning and practice in cognitive and practical domains, resulting in increased expertise and a more comprehensive understanding of their roles and responsibilities (Benner, 1982, 2004). The nurses utilized a practice guideline that had been analyzed and synthesized from empirical evidence, making it applicable to real nursing practice and serving as a framework for preventing increased IICP in hemorrhagic stroke patients. This ultimately led to a reduction in disease severity and complications (Kochaipath & Intari, 2019).

Nursing Practices and Clinical Control for Preventing IICP in Hemorrhagic Stroke Patients

After implementing the guideline, nursing practices for preventing IICP were generally high, including assessment of signs and symptoms and IICP prevention. This was attributed to their extensive experience in caring for hemorrhagic stroke patients, with most having over 10 years of work experience. All participants held bachelor's degrees, and many had specialized four-month training in neuroscience and neurosurgical nursing. These characteristics align with previous studies associating educational level, experience in caring for hemorrhagic stroke patients, and specialized neuroscience nursing training with effective nursing practices in preventing IICP in brain surgery patients. Observations of participants' nursing practices revealed generally correct performance after utilizing the guideline. However, some errors were noted, such as incorrect assessment of VAI in patients with indwelling EVDs. One beginner nurse, despite recent completion of a mentorship program and training with the standardized nursing practice guideline, incorrectly set the zero-reference point. Such errors are considered latent failures, possibly stemming from lack of experience, and requiring ongoing learning and guidance from more experienced nurses. While the CNPG helps beginner nurses gain confidence in caring for complex neurological patients, occasional errors may still occur. For example, two nurses incorrectly performed the assessment of level of consciousness using GCS, consistent with findings by Sanchan et al. (2021) on errors in patient assessment and nursing activity performance

among head injury patients. Nursing care activities, such as positioning the head, neck, and body correctly, were also occasionally performed incorrectly, possibly due to distractions during patient care. This phenomenon highlights the risk of slip or lapse errors when nurses lose concentration during tasks, emphasizing the importance of maintaining focus during patient care activities (Sanchan & Thongdornbom, 2022; Thungjaroenkul, 2018).

Nurses' Perceived Feasibility of Implementing the CNPG for Preventing IICP in Hemorrhagic Stroke Patients

Participants reported a high overall perceived feasibility of implementing the nursing practice guideline, which aligns with a study by Thaipakdee (2022) on CNPG for acute kidney injury assessment and prevention among registered nurses in surgical ICUs, which reported overall perceived feasibility of implementation and satisfaction with the guidelines was high. The participants in our study expressed high acceptability, demonstrated by their satisfaction and continuous implementation of the guideline. They also perceived the guideline as beneficial, applicable, situationally appropriate, and culturally consistent, indicating a high demand. In terms of implementation, participants found the content of the CNPG easy to understand, with clear prevention guidelines and few obstacles (Thaipakdee et al., 2022). The guideline facilitates standardized care for all hemorrhagic stroke patients, aiding in prompt diagnosis, informed nursing decision-making, timely reporting of abnormal findings, and expedited treatment responses, including monitoring for potential complications. Regarding practicality, participants reported the ability to learn and effectively utilize the guideline, with patients receiving prompt responses to treatment recommendations. Furthermore, nurses perceived the guideline as immediately implementable and facilitative of a more rapid assessment of IICP. Regarding expansion, participants expressed acceptance and a desire to utilize the guideline, perceiving it as accurate, clear, and conducive to standardized, high-quality nursing care consistent with medical directives. Notably, the guideline was deemed suitable for development into an organizational policy (Wongtawee et al., 2021).

Strengths and Limitations

The strength of this study lies in the comprehensive development of the CNPG based on NREM theory and Soukup's evidence-based practice guideline development model. Additionally, the study was implemented in a real-world setting, allowing nurses to learn through the process. However, the study had limitations: (1) being conducted at a single institution, which may limit generalizability to other settings, although the process and findings can provide insights for adapting guidelines elsewhere and (2) the nursing practice

questionnaires only assessed practice frequency, whereas assessing the quality of practice is also essential.

Implication for Practice

The findings from this study indicate that the CNPG was feasible to use and led to improvements in nurses' knowledge and practice. The study suggests implementing and expanding the IICP prevention guideline into a comprehensive nursing manual with standardized educational materials for consistent training in ICU and surgical wards. It is recommended to implement the CNPG and evaluate long-term outcomes, such as reduced complications, shorter ICU and hospital stays, lower healthcare costs, and enhanced satisfaction among patients and families.

Conclusions

The CNPG is of significant importance for standard nursing care, particularly in critical patients like those with hemorrhagic stroke who are at risk for serious complications such as IICP. This study demonstrates the comprehensive development of the CNPG for preventing IICP in these patients, encompassing assessment, prevention, management, and seamless care. Moreover, after implementing CNPG, nurses' knowledge was significantly improved. The nursing practices for preventing IICP were generally high, including assessment of signs and symptoms of IICP for prevention. Regular competency assessments are recommended to foster professional growth.

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Supplemental Material

Supplemental material for this article is available online.

References

Ashkan, S. M., Patrice, L. L., Ana, A., Anne, C., Mark, C., & Kerstin, D. E., …& Co-chair. (2020). On behalf of the Canadian Stroke Best Practices Advisory Committee in Collaboration with the Canadian Stroke Consortium and the Canadian Hemorrhagic Stroke Trials Initiative Network (CoHESIVE): Canadian stroke best practice recommendation: Management of spontaneous intracerebral hemorrhage, 7th edition update. *Journal of Stroke*, *16*(3), 321–341. https://doi.org/10.1177/1747493020968424

Benner, P. (1982). From novice to expert. *American Journal of Nursing*, *82*(3), 402–407. https://journals.lww.com/ajnonline/citation/1982/82030/from_novice_to_expert.4.aspx

Benner, P. (2004). Using the Dreyfus model of skill acquisition to describe and interpret skill acquisition and clinical judgment in nursing practice and education. *The Bulletin of Science, Technology and Society*, *24*(3), 188–199. https://doi.org/10.1177/0270467604265061

Bowen, D. J., Kreuter, M., Spring, B., Cofta-Woerpel, L., Linnan, L., Weiner, D., & Fernandez, M. (2009). How we design feasibility studies. *American Journal of Preventive Medicine*, *36*(5), 452–457. https://doi.org/10.1016/j.amepre.2009.02.002

Browne, R. H. (1995). On the use of a pilot study for sample size determination. *Statistics in Medicine*, *14*, 1933–1940. https://doi.org/10.1002/sim.4780141709

Carney, N., Totten, A. M., O'Reilly, C., Ullman, J. S., Hawryluk, G. W., Bell, M. J., & Ghajar, G. (2017). Guideline for the management of severe traumatic brain injury, fourth edition. *Brain Trauma Foundation TBI Guidelines*, *80*(1), 6–15. https://doi.org/10.1227/NEU.0000000000001432. PMID: 27654000

Chuaychang, S. (2018). Effects of using the assessment of the modified early warning signs (MEWS) in the assessment and monitoring change symptom of patients in cardiac catheterization lab, Trang hospital. *Thai Journal of Cardio-Thoracic Nursing*, *29*(1), 72–83. https://he02.tcithaijo.org/index.php/journalthaicvtnurse/article/view/148161/109058

Chunbang, S., Wongvatunyu, S., & Aree-Ue, A. (2013). Selected factors related to nursing practice for preventing increased intracranial pressure in patients with brain surgery. *Ramathibodi Nursing Journal*, *19*(2), 264–276. https://www.rama.mahidol.ac.th/nursing/sites/default/files/public/research/Nation/2556/ab%20no%2019.pdf

Dilorio, C., & Price, M. E. (2001). Description and use of neuroscience nursing self-efficacy scale. *Journal of Neuroscience Nursing*, *33*(3), 130–134. https://doi.org/10.1097/01376517-200106000-00004

Duangkaew, A., & Jumpamool, A. (2018). Effect of case management for hemorrhagic stroke patients on length of stay, cost of care, and provider's satisfaction. *Journal of Nursing and Health Care*, *36*(3), 42–50. https://he01.tci-thaijo.org/index.php/jnat-ned/article/view/150582/110318

Feigin, V. L., Brainin, M., Norrving, B., Martins, S., Sacco, R. L., Hacke, W., & Lindsay, P. (2022). World stroke organization (WSO): Global stroke fact sheet 2022. *International Journal of Stroke*, *17*(1), 18–29. https://doi.org/10.1177/17474930211065917

Feigin, V. L., Norrving, B., & Mensah, G. A. (2017). Global burden of stroke. *Circulation Research*, *20*(3), 439–448. https://doi.org/10.1161/CIRCRESAHA.116.308413

Greenberg, S. M., Ziai, W. C., Cordonnier, C., Dowlatshahi, D., & Francis, B., ...& American Heart Association/American Stroke Association (2022). 2022 Guideline for the management of patients with spontaneous intracerebral hemorrhage: A guideline from the American Heart Association/American Stroke Association. *Stroke*, *53*(7), e282–e361. https://doi.org/10.1161/STR.0000000000000407

Hester, L. L., Gifkins, D. M., Belles, K. M., Vermeulen, J., Schecter, J. M., Strony, J., Dishy, V., & Weiss, B. M. (2001). Diagnostic delay and characterization of the clinical prodrome in AL amyloidosis among 1523 US adults diagnosed between. *European Journal of Hematology*, *107*(4), 428–435. https://doi.org/10.1111/ejh.13679

Hussein, M., Zettel, S, & Suykens, A. M. (2017). The ABCs of managing increased intracranial pressure. *Journal of Nursing Education and Practice*, *7*(4), 6–14. https://doi.org/10.5430/jnep.v7n4p6

Irvine, D., Sidani, S., & Hall, L. M. (1998). Finding value in nursing care. A framework for quality improvement and clinical. *Nursing Economic*, *16*(3), 110–116.

Julious, S. A. (2005). Sample size of 12 per group rule of thumb for a pilot study. *Pharmaceutical Statistics*, *4*, 287–291. https://doi.org/10.1002/pst.185

Kaewpetch, U. (2021). The Effectiveness of the Modified Early Warning Score (MEWS) for surveillance of patients before entering crisis inpatient department Sikhio hospital Nakornratchasima province, region 11. *Medical Journal*, *35*(1), 1–11. https://he02.tci-thaijo.org/index.php/Reg11MedJ/article/view/247280

Kochaipath, P., & Intari, L. (2019). The development of nursing care model for traumatic brain injury patients in community hospital. *Journal of Phrapokklao Nursing College*, *30*(2), 203–218. https://he01.tci-thaijo.org/index.php/pnc/article/view/195026/139329

Leksomboonsuk, K. (2021). Nursing patients with Subdural hematoma to prevent severe cerebral hemorrhage using the Critical Early Warning System (MEWS). *The Journal of Boromarjonani College of Nursing Suphanburi*, *4*, 40–54. https://he02.tci-thaijo.org/index.php/SNC/article/view/256715

Moore, C. G., Carter, R. E., Nietert, P. J., & Stewart, P. W. (2011). Recommendations for planning pilot studies in clinical and translational research. *Clinical and Translational Science*, *4*(5), 332–337. https://doi.org/10.1111/j.1752-8062.2011.00347

Phumboonchu, N, & ., & Malasai, N. (2019). The effectiveness of using the Modified Early Warning Signs in emergency patients at the Emergency Department, Selaphum Hospital. *Journal of Research and Health Innovative Development*, *1*(1), 21–30. https://he01.tci-thaijo.org/index.php/jrhi/article/view/253671

Phunawakul, S., Reungsri, N., Montarak, O., & Kongros, J. (2017). The development of clinical nursing practice guideline for patients with surgery from traumatic brain injury in Phichit hospital. *Journal of the Department of Medical Services*, *42*(6), 102–107. https://he02.tci-thaijo.org/index.php/JDMS/article/view/248672/169123

Pin-Noi, R., Bunchucherd, P., Bua-Lad, N., & Tongpeth, J. (2021). The development of an assessment system on clinical deterioration monitoring using Phachomklao Modified Early Warning Sign Scores (PCK MEWS Scores) among intracerebral hemorrhage patients. *Journal of Nursing and Public Health Research*, *1*(3), 72–88. https://he02.tcithaijo.org/index.php/jnphr/article/view/255010/173546

Pongsavang, S., Anpunya, C., & Poonsem, S. (2020). Development of ABCs nursing practice guideline for acute hemorrhagic stroke patients in the surgical intensive care unit at Chiang Mai neurological hospital. *Journal of the Department of Medical Services*, *45*(1), 78–85. https://he02.tci-thaijo.org/index.php/JDMS/article/view/

Prachuablarp, C. (2018). Increased intracranial pressure in patients with brain pathology: A dimension of evidence-based nursing practice. *Thai Journal of Nursing Council*, *2*(33), 15–28. https://he02.tci-thaijo.org/index.php/TJONC/article/view/111187/102462

Pukkungvayung, P., & Sittipakorn, S. (2022). The development of a clinical nursing practice guideline for prevention of increased intracranial pressure in patients with external ventriculostomy at roi-ed hospital. *Journal of Nursing and Health Care*, *39*(1), 99–107. https://he01.tci-thaijo.org/index.php/jnat-ned/article/view/247223

Ritklar, L. (2016). The results of using the evaluation form for early warning signs on unplanned ICU admission and mortality rate in internal medicine ward at Thammasat University Hospital. *Thammasat University Hospital Journal online*, *1*(1), 5–12. https://he02.tci-thaijo.org/index.php/TUHJ/article/view/240161

Sanchan, M, & Thongdornbom, S (2021). Pitfalls of nursing Care in head injury patients with increased intracranial pressure. *Journal of Public Health Nursing*, *35*(2), 139–153. https://he01.tcithaijo.org/index.php/phn/article/view/249704/170286

Sanchan, M., & Thongdornbom, S. (2022). Pitfalls of nursing care in head injury patients with increased intracranial pressure. *Journal of Public Health Nursing*, *35*(2), 139–153. https://he01.tci-thaijo.org/index.php/phn/article/view/249704/170286

Shafi, S., Dias-Awastia, R., Madden, C., & Gentilello, L. (2008). Intracranial pressure monitoring in brain-injury patient are associated with worsening of survival. *The Journal of Trauma Injury Infection and Critical Care*, *64*(2), 335–340. https://doi.org/10.1097/TA.0b013e31815dd017

Soukup, M. (2000). The center of advanced nursing practice evidence-based practice model. *Nursing Clinic of North America*, *35*(2), 301–309. PMID: 10873242. https://doi.org/10.1016/S0029-6465(22)02468-9

Thaipakdee, S., Phinitkhajorndech, N., & Chaiviboontham, S. (2022). A study of the feasibility of clinical nursing practice guidelines for assessment and prevention of acute kidney injury in critical surgical patients. *Journal of The Royal Thai Army Nurses*, *23*(1), 313–322. https://he01.tci-thaijo.org/index.php/JRTAN/article/view/241595/173069

Thungjaroenkul, P. (2018). Systematic management for patient safety achievement. *Nursing Journal*, *45*(2), 148–156. https://he02.tci-thaijo.org/index.php/cmunursing/article/view/145128

Tiamkao, S. (2022). The incidence of stroke in Thailand. *Thai Journal of Neurology*, *39*(2), 39–46. http://neurothai.org/images/journal/2023/vol39_no2/06%20Original%20Somsak%20Ubatkarn.pdf

Tummikakul, Y. (2020). Effects of nursing practice guideline implementation by using modified early warning scores recording for sepsis patients of inpatient department, Thayang Hospital, Phetchaburi Province. *Journal of Prachomklao College of Nursing*, *3*(1), 31–46. https://he01.tci-thaijo.org/index.php/pck/article/view/235961

Wongtawee, T., Siripitayakunkit, A., & Jianvitayakij, S. (2021). Evaluation of the utilization of nursing practice guidelines for sepsis management on clinical outcomes among patients with sepsis in medical units. *Ramathibodi Nursing Journal, 26*(2), 155–171. https://he02.tci-thaijo.org/index.php/RNJ/article/view/241869/170193