

A Comparative Effectiveness Study in Health Care Management of Neurosurgery Patients by Bangkok International Hospital Case Manager Nurse

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Abstract

OBJECTIVES: To compare effective health care management practices, with a focus on three dimensions consisting of internal process, utilization management (UM) and financial management (FM) between patients who received clinical coordination interventions by case management (CM) nurse and usual standard of care of neurosurgery patients at Bangkok International Hospital (BIH).

MATERIALS AND METHODS: This study is a retrospective chart review. This research collected data from neurosurgical patients, namely confirmed cases by neurosurgeons. They have undergone brain surgery procedures and have been admitted to BIH during a period of 3 years from 1st January 2019 - 30th June 2022. We compared the outcome variables between two groups (The control group received usual care and the post-intervention group received clinical coordination by CM nurse) to assess the effectiveness of health care management. This consisted of the internal process, UM and FM. These data were analyzed using statistics with descriptive statistics and the independent t-test.

RESULTS: Of a total of 372 neurosurgical cases, 235 cases (63.2%) met the inclusion criteria. More than half of cases were male (58.3%). The mean age was 60.6 ± 16.6 years. Most of them 181 (77.0%) were admitted to the neuro ward. The diagnosis included Stroke 100 (42.5%), Brain Tumor 86 (36.6%) and Traumatic Brain Injury (TBI) 27 (11.5%), respectively. The post-intervention group presented obviously higher compliance rates of 87.2% with a patient/family care team meeting and 79.2% discharge planning, respectively. The post-intervention group had lower costs (0.1%) of Risk Management than the control group (0.4%). Meanwhile, the control group had lower cost of bad debts expenses per year than the post-intervention group. That may have been an effect of some patients in the post-intervention group not having an insurance coverage of 100% of medical costs and could not afford the care. The comparison of the LoS in the control group showed significant differences, and less than those in the post-intervention group ($p < 0.05$).

CONCLUSION: These results indicate that CM nurses can decrease risk management costs. Although, this study does have limitations. We have seen a positive trend towards using our CM model as this can assist in the improvement of quality in health care management through an effective care team meeting and discharge planning for our neurosurgical patients and their family. However, future studies should control confounding variables and more study is needed into other factors that may affect clinical outcomes.

Keywords: health care management, case manager nurse, outcome of neurosurgical patients

Patients with neurological disorders such as, Brain Tumor, Stroke, Cerebral Aneurysm and TBI may require brain surgery for full recovery. These are high-risk diseases and need specific care related to complex illnesses. There were also various factors associated with their outcomes. Therefore, these patients focused on the immediate assessment and management of neurological problems. It includes recommendations appropriate to patient safety and improved outcomes of each individual patient.¹

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Even though neurological patients have complex needs and require specific nursing care by a professional team, recent study of the quality-of-care processes in nursing show that healthcare providers lack adequate coordination of care and there remains poor communication among medical staff and patients. This could negatively affect patients' outcomes and cause a perception of missed nursing care, misunderstandings, and increased patient dissatisfaction.^{2,3} These issues need to be managed by the appropriate utilization of hospital services, especially in patients with multiple chronic diseases. This lack of coordination may have a detrimental effect on the quality of health care management provision and lead to higher costs.

The CM nurses' model was created by healthcare professional specialists from the Case Management Society of America (CMSA). They developed and published the CM guidelines and guidance documents. CM is defined as "a participative process of assessment, planning, facilitation, coordinate care, evaluation and support for services and patient needs through communication and available resources".⁴

However, these model have not been standardized to account for complex cases given the variety of CM roles and characteristics of patients with non-specific symptoms.⁵ According to previous study from United Kingdom Multidisciplinary Community barriers were found in the roles of CMs, including lack of clarity over responsibilities, lack of skills and training,⁶ difficulty in remaining continuously connected with the care team⁷ with some roles overlapping.⁸

In Thailand, CM nurse are used widely in chronic disease management, such as diabetic, hypertension, and cancer.^{9,10} However, the effectiveness of interventions and management of other specific diseases is not clear. The CM model of Bangkok Hospital Headquarters has been developed since the end of 2019. It adapted standards of practice from the CMSA⁵, and the Oregon Health & Science University (OHSU).¹¹ Likewise, Executives and Nursing Committees established a competency framework for the CM nurse detailing the need for specific knowledge, professional skills and positive attitudes at work as follows:

Knowledge	Skills	Attitude
<ul style="list-style-type: none"> Follow Center of Excellence or Integrated Practice Units Third party payer Utilization Management Transcultural Nursing Resources outside the hospitals in the community Nursing and medical ethic Risk management and Quality review 	<ul style="list-style-type: none"> Communication skill Counseling skill Leadership skill Critical thinking Strategic thinking Deep listening Organizing skill Goal-oriented Computer skill 	<ul style="list-style-type: none"> Empathetic Flexibility Be ethical Patient and family advocate

Figure 1: CM nurse competency standards of Bangkok Hospital Headquarters

A fully qualified CM nurse is a registered nurse with more than 7 years of nursing experience. Candidates must display characteristics such as: critical thinking, self-directed learners, nurse leaders, problem solvers, advocates, effective communicators, highly organized, brave and fearless. In addition, they are also required to obtain a training certificate (16 hours). The CM nurse mandatory course include: Case manager concepts, third party payer services and UM, risk management, nursing and medical ethics and dilemmas, conference models, complaints management and negotiation, and so on.

Elements of the Key Performance Indicators (KPIs) of CM nurses at BIH have been developed by Executives and Nursing Committees through focus group discussions.

KPIs are divided into 3 main perspectives: internal process, financial and customer (patient experience measured by Customer Satisfaction Index: CSI scores and UM).¹² However, the researcher focused only on UM as the patients' CSI score is analyzed as part of an overview of general nurses each month.

Moreover, CM main roles and responsibilities are: coordinating with patients, family, care providers and third parties to provide an optimal care plan and outcomes that are safe, timely, efficient, equitable, patient-centered and the provision high quality health care. More details on the CM nurse work flow and standard of practice can be seen in Figure 2.

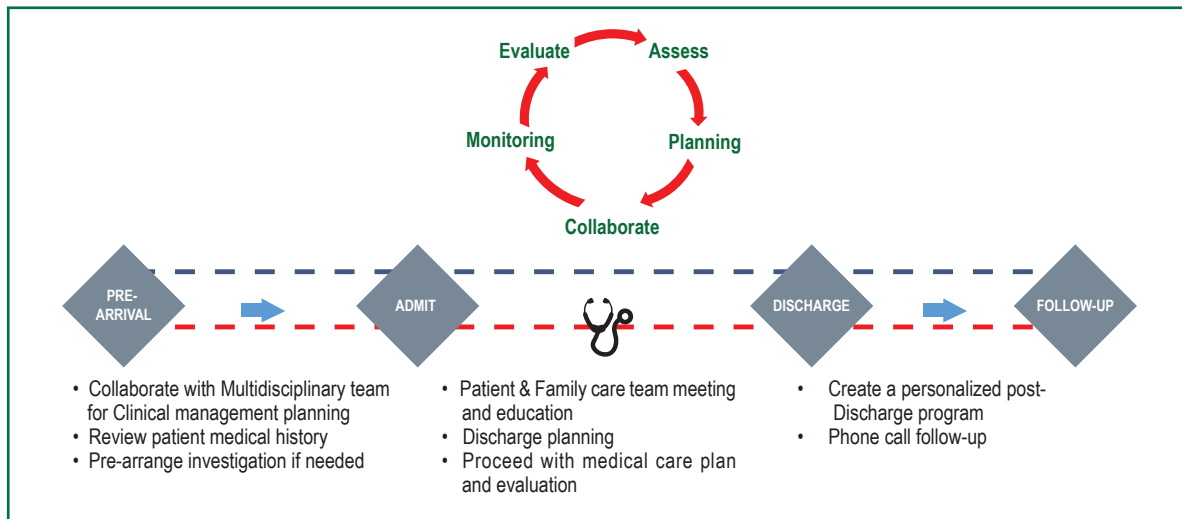


Figure 2: Case Management work flow in BIH

This study emphasized patients with neurosurgical interventions as many of these patients have complex conditions, are at high risk and their care incurs higher costs. Neurosurgical interventions can have an impact on the long-term quality of life and outcomes.¹³⁻¹⁵ Therefore, the researcher was interested in the specific duties included in the effective health care management of CM nurses. There are no prior study reviews, nor have any articles yet been published in private hospital sector of Thailand. The researcher reviewed literature to identify and evaluate the success of the CM model as a delivery model, and to provide insight for future CM research and improved practice in Bangkok Dusit Medical Services (BDMS) network or other hospitals.

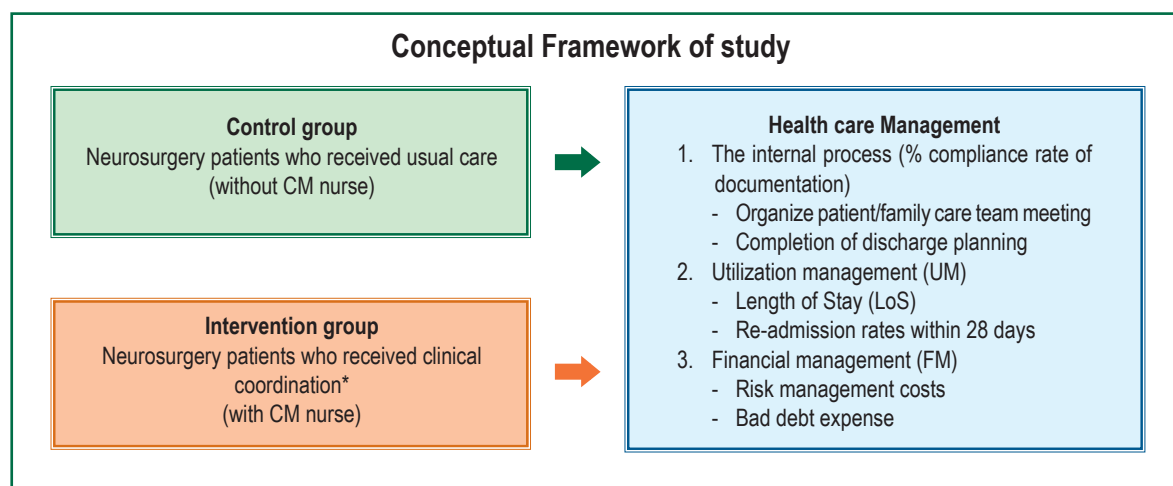
Materials and Methods

The aim of this research was to compare the effectiveness of health care management between neurosurgery patients who received a usual standard of care, as the control group, and patients who received clinical coordination by a CM nurse, as

the post-intervention group. The health care management compared 3 dimensions. These consisted of the internal process (%compliance of organize the patient/family care team meeting and completion of discharge planning), UM (LoS and re-admission rates within 28 days) and FM (risk management cost and bad debt expense).

This research collected data from neurosurgical patients, namely confirmed cases by neurosurgeons. They have all undergone brain surgery procedures and have been admitted to BIH during a period of 3 years (January 1, 2019 - June 30 2022).

A retrospective comparative study design was used for this research. After the Institutional Review Board: IRB of BDMS approval was received (Protocol ID: BHQ-IRB 2022-05-25, COA: dated 1 August 2022). Permission to use data and to waive consent was granted by the BIH Director. The subjects were purposively selected with the following inclusion criteria as detailed below:



*Clinical coordination is responsible for overseeing and organizing the quality of patient care, e.g. manage care team meetings, communicate with multi-professional team, educate and advise patient/family, ensure a high standard of care, monitor and prevent risks that may occur while hospitalized.¹²

Inclusion criteria

The screening criteria for the sample met the following parameters:

1. Neurosurgery patients aged ≥ 15 years old.
2. Patients diagnosed as cases by neurosurgeons, with conditions such as: Brain Tumor, Stroke, TBI, Cerebral Aneurysm, and so on.
3. Patients have undergone brain surgery procedures and were admitted or referred in for continuous treatment in the intensive care units (ICU) or in-patient department (IPD) at BIH.
4. Case risk management covers both clinical and non-clinical risk, such as patients needing to repeat surgery (re-operation), patients with surgical site infection (SSI), unexpected complications from surgery, patients developing operation with comorbidity (requiring hospitalization >7 days) or patients with financial risks.

Exclusion criteria

1. Patients who were referred out to other hospitals during their treatment.
2. Patients who had no family contact, no multiple organ injury or complex illness.
3. Patients who died during the hospital stay.

Sample size calculation

The sample size was calculated by reference to previous similar studies¹³ to estimate the sample size required to differentiate two means. The minimum number of participants required for this study was 93 for each group from calculation, which was approved by a biostatistician according to the formula below:

The formula for sample size estimate: comparison of two means (independent) of the population¹⁴

$$n_1 = \frac{\left(z_{1-\frac{\alpha}{2}} + z_{1-\beta}\right)^2 \left[\sigma_1^2 + \frac{\sigma_2^2}{r}\right]}{\Delta^2}$$

$$r = \frac{n_2}{n_1}, \Delta = \mu_1 - \mu_2$$

$$n_1 = \frac{\left(z_{1-\frac{0.5}{2}} + z_{1-0.2}\right)^2 \left[16.6_1^2 + \frac{12.7_2^2}{1}\right]}{12.9 - 6.8^2}$$

$$n_1 = 93$$

n	=	total sample size
$Z[1-(\alpha/2)]$	=	related to the chosen significance criterion α ; see in table of standard normal distribution = 1.96 (Two-Tailed)
$Z(1-\beta)$	=	related to the chosen power, or sensitivity of the experiment
α	=	alpha = 0.05 or Level of Confidence at 95 %
β	=	the type 2 error < 20% (0.2) or power of test > 80%
σ	=	variance or assumed (the standard deviation: SD) ²
r	=	proportions of sample size
Δ	=	the difference of $\mu_1 - \mu_2$ (The population mean from population 1) minus (the population mean from population 2)
u	=	the population mean

Instruments

The case record form (CRF) was created by the researchers. That was developed from a review of related literature and following the CM nurse KPIs of BIH.¹² The three experts in the nursing staff organization of BHQ verified and evaluated the appropriateness in terms of the content validity of the CRF. Then the researchers revised contents in the CRF following their suggestions. It was divided into 2 parts:

- **Part 1:** The demographics and clinical characteristics of participants, including gender, age, department of patient admission, diagnosis, comorbidity and complication
- **Part 2:** The effectiveness in health care management divided into 3 dimensions; internal process, UM and FM.

Data collection

After IRB approval, the researcher reviewed the data of neurosurgery patients from their electronic medical records (EMRs) and recorded these in the CRF. They were selected using a simple random sampling method.

Each patient was assigned with a subject identification number to ensure personal data protection and to respect patients' confidentiality. The study sample included 235 cases, the analysis of this study is a two-group design; the first group is the control group who received usual care ($n = 110$) between January 1, 2019 - June 30, 2020, and the second group is the post-intervention group who received clinical coordination by CM nurse ($n = 125$) between January 1, 2021- June 30, 2022.

Statistical analysis

The researcher checked the data completeness and entered the data to the IBM SPSS program, version 22.0. The *p*-value was based on two-tailed tests, with a significant level of less than 0.05, using statistical methods as follows:

1. The demographic and clinical characteristics data of participants were analyzed by using descriptive statistics. That was frequency distribution, percentage values, mean and SD.
2. Analysis according to objectives were divided into 3 dimensions. This compared the control group and the post-intervention group, as follows:
 - 3.1 Comparing the internal process of care management, consisting of a compliance rate of organizing the patient/family care team meeting and completion of discharge planning by using a percentage.
 - 3.2 Comparing FM including risk management costs and bad debt expense in neurosurgery patients by using a percentage.
 - 3.3 Comparing UM, consisting of LoS and re-admission rates within 28 days by using statistical independent *t*-test.

Results

There was a total of 235 cases in this study. In the patients without a CM nurse, most of the patients were male (60.0%), at a similar rate to patients with a CM nurse (56.8%). The average age of the patients without a CM nurse was 61.6 ± 18.0 years, while the average age of patients who had a CM nurse was 59.8 ± 16.2 years. Most patients had been admitted to the neuro ward, both the control group and post-intervention group, 91 (82.7%) and 90 (72.0%) respectively.

The diagnosis in the patients without a CM nurse consisted of: Stroke 50 (45.4%), Brain Tumor 40 (36.4%), TBI 8 (7.3%) and other diagnosis 12 (10.9%). Likewise, patients who had a CM nurse consisted of: Stroke 50 (40.0%), Brain Tumor 46 (36.8%), TBI 19 (15.2%) and other diagnosis 10 (8.0%). A total of 56 (50.9%) patients without a CM nurse had current or previous comorbidities and 75 (60.0%) of patients with a CM nurse. Current complications were found in 12 (10.9%) of the patients without CM nurse and 48 (38.4%) of the patients who had a CM nurse (showed in detail in Table 1.)

Table 1: The demographic and clinical characteristics of neurosurgery patients

Total	Health care management (%)		
Demographic and clinical characteristics	Control group-Without CM nurse n = 110; (n(%))	Post-intervention-With CM nurse n = 125; (n(%))	Total n = 235; (n(%))
Gender			
Male	66 (60.0)	71 (56.8)	137 (58.3)
Female	44 (40.0)	54 (43.2)	98 (41.7)
Age (years)			
-x \pm SD	61.6 \pm 18.0	59.8 \pm 16.2	60.6 \pm 16.6
-Min – Max	29 – 96	18 – 91	18 – 96
Department of patient's admission			
Neuro ward	91 (82.7)	90 (72.0)	181 (77.0)
Other departments	19 (17.3)	35 (28.0)	54 (23.0)
Diagnosis			
Stroke	50 (45.4)	50 (40.0)	100 (42.5)
Brain Tumor	40 (36.4)	46 (36.8)	86 (36.6)
Traumatic Brain Injury (TBI)	8 (7.3)	19 (15.2)	27 (11.5)
Other diagnosis	12 (10.9)	10 (8.0)	22 (9.4)
Current or previous comorbidities			
Yes	56 (50.9)	75 (60.0)	131 (55.7)
No	54 (49.1)	50 (40.0)	104 (44.3)
Current complications			
Yes	12 (10.9)	48 (38.4)	60 (25.5)
No	98 (89.1)	77 (61.6)	175 (74.5)

The three most current or previous comorbidities in patients without CM nurse consisted of Hypertension 33 (30.0%), others diseases 26 (23.6%) and Diabetes 16 (14.6%). For patients who had a CM nurse there were higher comorbidities than patients without CM nurse. This consisted of others disease 70 (56.0%), Hypertension 57 (45.6%) and Dyslipidemia

35 (28.0%), respectively (seen in Figure 3). The common complications in patients without CM nurse consisted of seizure 7 (6.4%), sepsis 4 (3.6%) and others 4 (3.6%). While patients who had CM nurse had higher complications than patients without CM nurse. This consisted of sepsis 16 (12.8%), seizure 10 (8.0%) and others 8 (6.4%) (seen in Figure 3-4).

Most 87.2% compliance rates in patients who had a CM nurse had completely documented the patient/family care team meeting. Including 79.2% of compliance rates documenting discharge planning. For patients without a CM nurse, these had lower compliance rates than patients who had a CM nurse. Those that were completely documented were 30% in organizing the patient/ family care team meeting and 32.7% documenting the discharge planning (see detail in Table 2).

The final mean scores comparison of the LoS in patients without CM nurse (14 ± 14.3) were lower than patients who had CM nurse (18 ± 16.1) in the final LoS scores. The

comparison of LoS between patients without a CM nurse and patients with a CM nurse showed significant differences in the LoS ($p < 0.05$). While the re-admission within 28 days was found 1 (0.8%) of patients who had a CM nurse (details in Table 3).

The costs of Risk Management of patients who had a CM nurse were found to be 0.10%. This is lower than patients without a CM nurse, which were found to be 0.44%. Meanwhile, patients without a CM nurse had 13.6 million baht of bad debt expense, this was less than patients who had a CM nurse, of 15.8 million baht per year (Table 4).

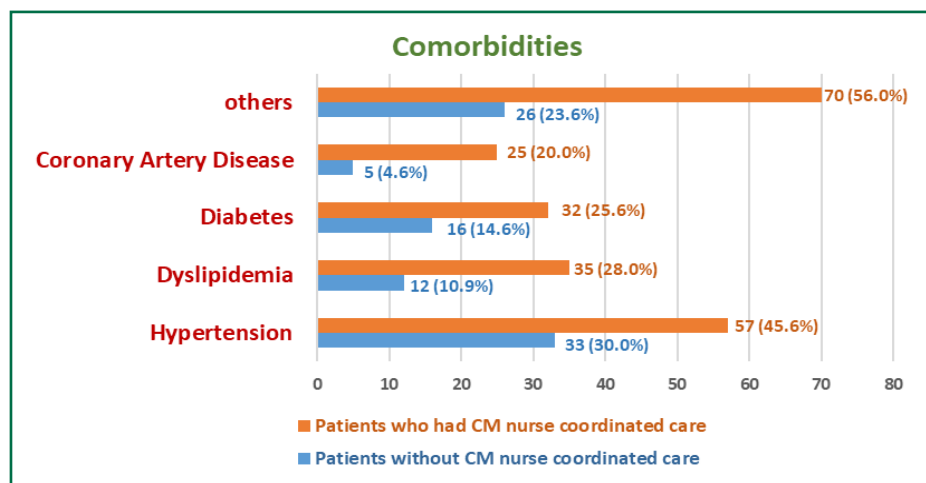


Figure 3: Total of comorbidities in neurosurgery patients

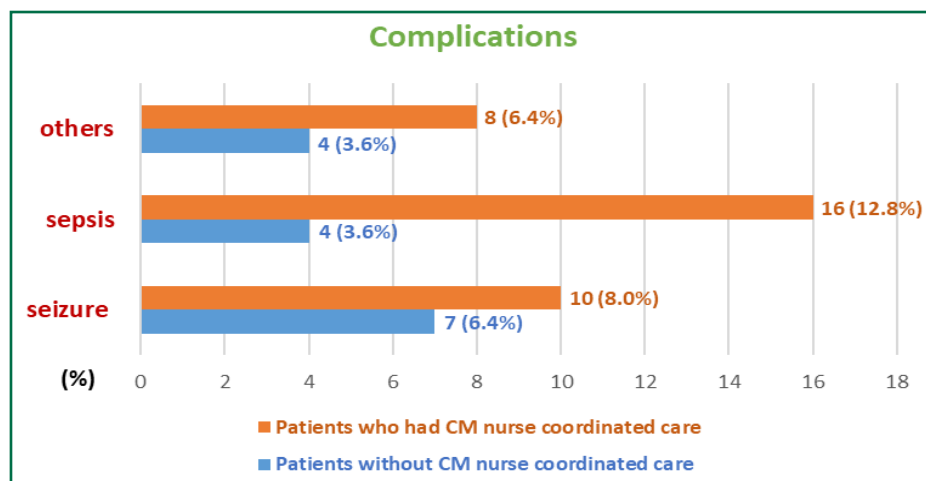


Figure 4: Total of complications in neurosurgery patients

Table 2: The compliance rates of the internal process dimensions in health care management (n = 235)

Demographic data	Compliance (%)			
	Control group-Without CM nurse n = 110; (n(%))		Post-intervention-With CM nurse n = 125; (n(%))	
	Yes	No	Yes	No
Organize patient/ family care team meeting	33 (30.0)	77 (70.0)	109 (87.2)	16 (12.8)
Completion of discharge planning	36 (32.7)	74 (67.3)	99 (79.2)	26 (20.8)

Table 3: Utilization Management (UM) of neurosurgery patients (n = 235)

Utilization outcomes	Health care management		t	p
	Control group-Without CM nurse n = 110	Post-intervention-With CM nurse n = 125		
Length of stay: LOS (day)			2.094	0.037 *
X ± SD	14 ± 14.3	18 ± 16.1		
min - max	2 - 76	2 - 88		
Re-admission within 28 days (%)				
Yes	0	1 (0.8%)		
No	110 (100%)	124 (99.2%)		

* $p < 0.05$ **Table 4:** Financial Management (FM) of neurosurgery patients (n= 235)

Topic	KPIs Target (per year)	Health care management (%)	
		Control group-Without CM nurse n = 110	Post-intervention-With CM nurse n = 125
Risk Management costs per Core Revenue (%)	< 0.5%	0.44	0.10
Bad Debts expense (million baht)		13.6	15.8

Discussion

This study focused on the outcome of neurosurgery patients. Further details of results were in accordance with three objectives as follows:

First, EMRs have become a widely accepted source of data for patients' safety and patient outcomes. Communication between medical staff, patients and their families on discharge planning sheets has been reported to be inadequate and there is a gap in communication.¹⁵ The current practice in BIH is that nurses evaluate patient conditions and input data entry in the Patient Admission Assessment form of their EMRs. They are also responsible for preparing discharge planning after hospitalization within 24-48 hours. However, some situations were found of patients not having completed discharge planning. Our findings may be consistent with earlier study as it is difficult to predict the day of hospital discharge precisely.¹⁶ For example, caregivers may be required to refer their patients to another facility for further treatment or long-time physical therapy. Most referral processes are serviced at busy times. That may result in a loss of communication on the day of discharge among CM nurses, the multidisciplinary team and caregivers. Consistent with our study, it demonstrates that patients who had a CM nurse had a high compliance rate of complete documents with the patient/ family care team meeting 109 (87.2%). The patients without a CM nurse had a much lower compliance rate of just 33 (30.0%). It was also found that patients who had a CM nurse had a higher percentage rate of discharge planning meeting 99 (79.2%) than in patients without a CM nurse, namely 36 (32.7%). Therefore, the recommendations obtained from our study should be an increase in effective communication channels to facilitate two-way communication for information sharing about patient problems between the medical team and the CM nurse. Meanwhile, the EMRs system quality must remain reliable in terms of technical functionality, responding quickly to inputs and be easy to use. This can assist and encourage a greater

continuity of care and clarity within the medical care team working towards the same goal.¹⁸

Furthermore, the researcher recommends all CM nurse should re-assess discharge planning and arrange this 1-2 days before patients are due to be discharged from hospital or every day-7 for the patient who had been admitted for more than 7 days. This process is preparatory, and ensures the readiness and knowledge of both patient and caregiver before the illness transition phase from hospital to home takes place, or to nursing home or other their healthcare providers. The role of the CM nurse also facilitates coordination with the multidisciplinary team and caregivers to ensure increased participation in continuing care. This includes patient education on their needs that are adapted and appropriate to each patient, encouragement of self-healing, self-care management, and telehealth or phone calls for follow-up care.¹⁹⁻²¹ Understanding their medical management plans helps to improve care collaboration and personalized outcomes for complex patients.²² This can reduce stress and enhance the quality of life both of patients and their caregivers.²³

Second, our finding shows the final mean scores comparison of the LoS in the patients who had a CM nurse (18 ± 16.1) was longer than patients without a CM nurse (14 ± 14.3). The comparison of the LoS between the control group and the post-intervention group showed significant differences in the LoS ($p < 0.05$). Our results were consistent with a previous study in Singapore that showed the severity of illness and complications were associated with prolonged LoS. It increases the risk of hospital-acquired infection and disturbs an effective patient flow in older patients.²⁴ Consistent with our study, it demonstrates that the patients who had a CM nurse had a higher LoS than patients without a CM nurse. This may have been due to most of the patients who had a CM nurse were very complex cases, with higher severity conditions, with more comorbidities and complications than the patients who had a CM nurse, (see Figure 3-4). Comorbidities and

complications have been associated with more complex clinical management, and increased health utilization costs.²⁵ In-depth analysis found 48.2% of patients experienced a delay in their discharge date. There was a trend towards prolonged hospitalization with increasing patient age.²⁶ In addition, a recent study ad reported re-operative midline shift was the strongest negative outcome predictor. Especially in patients with delayed surgery and aged ≥ 70 years with subacute clinical degeneration.²⁷ Therefore, CM nurses may not directly assist in the reduction of the LoS in neurosurgery patients with more comorbidities and complications. However, CM should watch out for unnecessary delays in starting treatment and nursing care, and delays in surgery. This may help to improve safety, quality of practice and provide better outcomes.²⁸

The final mean scores comparison of the re-admission within 28 days found 1 (0.8%) of patients with a CM nurse, (Table 3). The researcher reviewed this re-admission case. There was an infection of the wound. The patient acknowledged this and was consequently a re-admission. This did not create a complaint or increase risk management costs. Our results were also consistent with previous study which found that deep surgical site infections were associated with re-hospitalization, prolonged LoS and increased costs.²⁹

Furthermore, hospital re-admission is common in survivors of critical illnesses and increases stress on the patients and their caregivers. According to a previous systematic review and meta-analysis study, re-admission rates after critical illness were 16.9% (95%CI: 13.3-21.2%) within 30 days.³⁰ In agreement with an earlier study it was found that re-admission rates were associated with improved patient outcome. In particular, high-risk patients were also associated with an increase in the hospital mortality rate and poor patient experience.³¹ CM nurses should proactively undertake a risk assessment and compare their medical care plan to ensure quality of patient-centered care standards are met and support staff in wards for specific nursing care provide a good patient experience and display empathy.³² This directly affects patient safety and improves patient outcomes.³³

Third, FM of neurosurgery patients as a risk management cost (KPIs of hospital target per year < 0.5 %) and bad debt expense in hospital per year. Clinical risk management is a direct role of nurses for patient safety. Our number of risk management costs were reported lower KPIs target per year than both groups. These cost of patients without a CM nurse was found to be 0.44% higher than in patients who had a CM nurse; this was found to be 0.10%. Meanwhile, bad debt expense per year increased from 13.6 million baht in patients without a CM nurse to 15.8 million baht per year in patients who had a CM nurse and coordinated care. One explanation may be that some patients in the post-intervention group did not have insurance coverage 100% of medical costs. They had limited personal budgets and could not afford the health care. That may be the cause of bad debt for the hospital. Factors affecting higher hospital expense and growing cost pressures,

include population ageing with chronic diseases, patients with high-risk factors, new technologies, patient and family expectations.³⁴ Furthermore, hospital expenses can occur from clinical risks, such as a prolonged discharge process,²⁴ delays in intervention,²⁷ complications after surgery and hospital readmission.³²⁻³⁴ These factors can increase hospital risk costs and lead to bad debt expense. Moreover, a recent cost analysis study of complications after patients with brain tumour craniotomy were reported at an estimated cost of approximately \$55,340,017 per year. Most complications were 9.78% of unplanned readmissions in 30 days, including surgical site infection and sepsis.³⁵ In accordance with a mixed-studies systematic review in European nations, UK and USA, reported up to 30.7% of total hospital costs led to extra bed-days or delayed discharge.³⁶ Especially, neurosurgical cases with complications have a high risk of prolonged LOS and high healthcare costs.

Finally, the researcher recommends all CM nurses should undertake pre-hospital patient condition assessments, arrange pre-operative cost estimates and provide optimal fees of hospitalization costs for neurosurgery patients. That is the one part of the hospital risk management process may mitigate, protect or decrease non-clinical and clinical risks within cost constraints. Especially pertinent in patients who have an insurance coverage plan that limits the amount of medical expenses or who have a limited personal budget and ability to make direct payments. In addition, CM nurses should also pay attention to continuous costs monitoring, share decision-making, advise, and provide problem solving for patients and caregivers. This can improve patient relationships and establish trust. It may also help to reduce conflicts resulting from charges above the estimated price.³⁷ Importantly, the patient be made aware of the duties of general nurses and a CM nurse's job responsibilities. Patients may be confused about the specific duties of CM nurses, because most of neurosurgery patients have chronic and complicated diseases. These patients may be coordinated by more than one CM nurse. Some CM nurses may hold more than one role in their care. The diversity and complexity of CM activities may affect the scope of CM nurse roles, their communication and patient interaction experience.³⁸

Study limitations of our study are its retrospective nature, and data was not controlled for confounding factors initially. As a result, the conclusions of our research findings are also limited and may miss important clinical data, such as neurological severity like Glasgow Coma Scale (GCS). This data may directly affect patient outcomes. Furthermore, the age range of the study subjects is quite large, which may cause an impact on the results of the study. In addition, a weakness of a comprehensive CM model may have outside pressures from an insurance company with fixed payment and healthcare economic impacts as an increase in health-care costs. Certainly, further research may challenge how to establish a culture which advocates for continuous improvement for proactive CM or to optimize healthcare utilization for improved patient experience to achieve health-related sustainable development goals.

Conclusion

Neuroscience CM nurses help to reduce risk management costs through an effective care team meeting and discharge planning. They also arrange personalized care coordination and collaborative management with multidisciplinary team for neurosurgery patients and their families. Although the study had limitations. Our CM model at the BIH has seen a positive trend towards using an implementation practice in the BDMS network and other hospital settings. However, future studies should control the confounding variables and consider more factors that may affect clinical outcomes.

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Conflict of interest

The authors declare no conflict of interest.

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