Received: 6 January 2021 | Revised: 1 April 2021 | Accepted: 11 May 2021

DOI: 10.1111/jjns.12437

ORIGINAL ARTICLE

JAPAN JOURNAL OF NURSING SCIENCE WILEY

Comparison of Japan nurse practitioner-led care and physician trainee-led care on patients' length of stay in a secondary emergency department: A retrospective study

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Abstract

Aim: We compared Japan nurse practitioner-led care and physician trainee-led care in terms of patients' length of stay in a secondary emergency department in Japan.

Methods: This was a retrospective observational study, utilizing medical records. Participants ($n = 1419$; mean age $= 63.9 \pm 23.4$ years; 52.3% men) were patients transferred to the emergency department by ambulance between April 2016 and March 2018 in western Tokyo. Multiple linear regression analyses were performed, with length of stay as the dependent variable and factors related to the length of stay, including medical care leaders, as the independent variable.

Results: Approximately half of the patients ($n = 763$; 53.8%) received Japan nurse practitioner-led care. Patients' length of stay was significantly shorter, by 6 min, in the Japan nurse practitioner-led care group, compared with the physician trainee-led care group (unstandardized coefficient: −6.81; 95% confidence interval: −13.35 to −0.26; $p < 0.05$).

Conclusion: Patients' shorter length of stay in the Japan nurse practitioner group, compared with the physician trainee group, suggests that Japan nurse practitioners are not inferior to physician trainees in terms of the time spent to manage patients.

KEYWORDS

advanced practice nursing, critical care, emergency department, emergency treatment, Japan, nurse practitioner

1 | INTRODUCTION

Demand for emergency medicine is increasing annually, with an increase in the number of presentations to hospitals (Burkett et al., 2017). However, owing to the uneven distribution of physicians and the enforcement of work training time limits for trainee physicians (Garland & Gershengorn, 2013; Kleinpell et al., 2015; Ward et al., 2013), the workload of emergency physicians is high. In addition, owing to the serious shortage of

emergency department (ED) staff, EDs face problems such as patients' increased waiting time and length of stay. A longer ED stay is associated with higher mortality rates (Chang et al., 2018; Singer et al., 2011; Sun et al., 2013) and prolonged hospital stay (Richardson, 2002), increasing patients' medical costs and reducing patient satisfaction (Imperato et al., 2014; Pines et al., 2008).

To solve these problems, health services have been remodeled significantly in response to healthcare demands. Increased public uptake of care provided by specialists, including nurse practitioners (NPs), can reduce care latency (Fry et al., 2011). In primary care and emergency medicine, NPs are being introduced worldwide as a solution to these problems (Jennings et al., 2008; Steiner et al., 2009; van der Linden et al., 2010), and patients' waiting time and dissatisfaction are declining (Middleton et al., 2011).

NPs are registered and certified nurses who have been educated to function autonomously and cooperatively in advanced and extended clinical roles. The Advanced Practice Nursing Regulations Consensus Model in 2008 provides primary, continuous, and comprehensive care—including comprehensive medical history; physical examinations and other health assessments and screening activities; diagnosis, care, and management of acute and chronic patients and diseases; ordering and conducting laboratory examinations and imaging examinations; interpreting examination results; prescribing drugs; using medical devices; and providing explanations to patients (Advanced Practice Registered Nurse [APRN] Consensus Group Work Group & The National Council of State Boards of Nursing APRN Advisory Committee, 2008). The International Council of Nurses' Nurse Practitioner/Advanced Practice Nursing Network (2020) also defines an NP as a registered nurse with expert knowledge, complex decision-making skills, and clinical competence—with legislated extensions for expanded practice. NPs acquire advanced knowledge and skills regarding pathophysiology, physical assessment, and pharmacology, which undergraduate programs in many countries cover to some degree, but not as thoroughly as the in-depth treatment provided by NP programs. They are clinically trained, hold master's degrees, and are certified. The number of NPs is increasing annually: there are 290,000 in the United States (American Association of Nurse Practitioners, 2020), 5697 in Canada (Canadian Nurses Association, 2018), and 1839 in Australia (Australian College of Nurse Practitioners, 2019). In addition, emergency care research has revealed that NPs provide valuable, safe, and effective services (McDevitt & Melby, 2015; McDonnell et al., 2015; Pirret et al., 2015).

Some studies have reported that when patients receive care from NPs and physicians in EDs, their length of stay is shorter than when care is received from physicians only (Jennings et al., 2008; Steiner et al., 2009; van der Linden et al., 2010). These studies claimed that NPs had a beneficial effect on patients' length of stay in the ED. However, other previous studies revealed no significant difference in patients' length of stay in the ED between an NP-provided care group and a physician-provided care group (Considine et al., 2006; Steiner et al., 2009). Others demonstrated that the medical hours of an emergency physician group were significantly shorter than that of an NP group (Byrne et al., 2000; Middleton et al., 2019). As such, there is no unified view on the relationship between NP-provided care and patients' length of stay in EDs.

In Japan, as in other countries, emergency medicine faces new social issues, owing to the rapidly aging population (Statistics Bureau of Japan, 2019) and increasing medical demand. To address this challenge, Japan NPs are assigned to the field of emergency care—often leading the provision of medical care, and sharing and shifting tasks with physicians. Japanese NP training commenced in 2008, in the form of a postgraduate master's degree program (Fukuda et al., 2014). Japan NP students receive intensive, advanced medical and nursing education, providing them with a broader scope of practice than nurses. Currently, 11 postgraduate schools are members of the Japanese Organization of Nurse Practitioner Faculties, and students must pass a qualification test to be certified as a Japan NP. By March 2020, 487 Japan NPs had been certified by the Japanese Organization of Nurse Practitioner Faculties. While the Japan Nursing Association is prioritizing the development of an NP system policy (Imoto, 2020), currently no formal legislative status has been established for NPs in Japan (Fougère et al., 2016), and Japan NP certification is not a national qualification. The scope of practice for Japan NPs is similar to that of United States NPs in restricted practice. In legislative terms, Japan NPs differ from nurses in that specific medical interventions (e.g., arterial punctures, correction of dehydration by intravenous drip, and adjusting the respiratory settings; Ministry of Health, Labour and Welfare, 2015) can be performed by NPs under physicians' instructions and by following protocols prepared by physicians. In some facilities, Japan NPs can prescribe stock medicines to outpatients and in wards on behalf of the physicians within a prepared protocol, with the instruction and approval of physicians in specific medical interventions. Furthermore, in Japanese EDs, NPs acquire and practice the knowledge, skills, and thought processes necessary for the provision of medical care, such as physical examinations, clinical reasoning, differential diagnosis, test selections, and the interpretation of test results.

Japan NPs provide medical care to patients as an adjunct to medical treatment based on nursing. Prior to the introduction of NPs to Japanese EDs, physician trainees were responsible for patients' initial care in the target facility. NPs are expected to provide more timely medical care to patients, allowing physician trainees and emergency physicians to focus on treating more critically ill patients. A study on the outcomes of Japan NPs' care could serve as a resource for the introduction of Japan NPs.

To the best of our knowledge, no such studies have yet examined the care outcomes of the Japan NP-led ED care. Although the scope of practice of Japan NPs is not yet at an international standard, there is a need to generate evidence for the development of the field under current law. Further, a reduction in the length of ED stays may contribute to higher patient satisfaction (Imperato et al., 2014; Pines et al., 2008), lower mortality rates (Singer et al., 2011; Sun et al., 2013), lower costs (Sun et al., 2013), and shorter hospital stays (Richardson, 2002; Singer et al., 2011; Sun et al., 2013). In the current study, Japan NPs' efficiency in the ED was evaluated using an objective measure. The objective of this study was to compare Japan NP-led care and physician trainee-led care in terms of patients' length of stay in a secondary ED.

1.1 | Term definitions

1.1.1 | Nurse practitioner (NP)

Officially qualified nurses who can perform a certain level of diagnosis and treatment without a physician's instructions, such as in the United States.

1.1.2 | Japan nurse practitioner (Japan NP)

Nurses who have completed the Japan NP master's degree curriculum, accredited by the Japanese Organization of Nurse Practitioner Faculties, passed the NP certification examination administered by the Japanese Organization of Nurse Practitioner Faculties, and who can perform a certain standard of medical care under a physician's instructions.

1.2 | Conceptual framework

The conceptual framework of this study is shown in Figure 1. The medical outcomes of NPs have been identified for safety, economy, and patient satisfaction. In this study, we compared the care provided by Japan NPs and physician trainees, focusing on the length of stay in the secondary ED, a measure of the efficiency of practice. We determined and compared the characteristics of patients in Japan NP and physician trainee groups, and adjusted for these characteristics. However, other confounding factors may have been excluded from the investigation.

2 | METHODS

2.1 | Design

This was a retrospective observational study, conducted with medical records covering the period between April 2016 and March 2018.

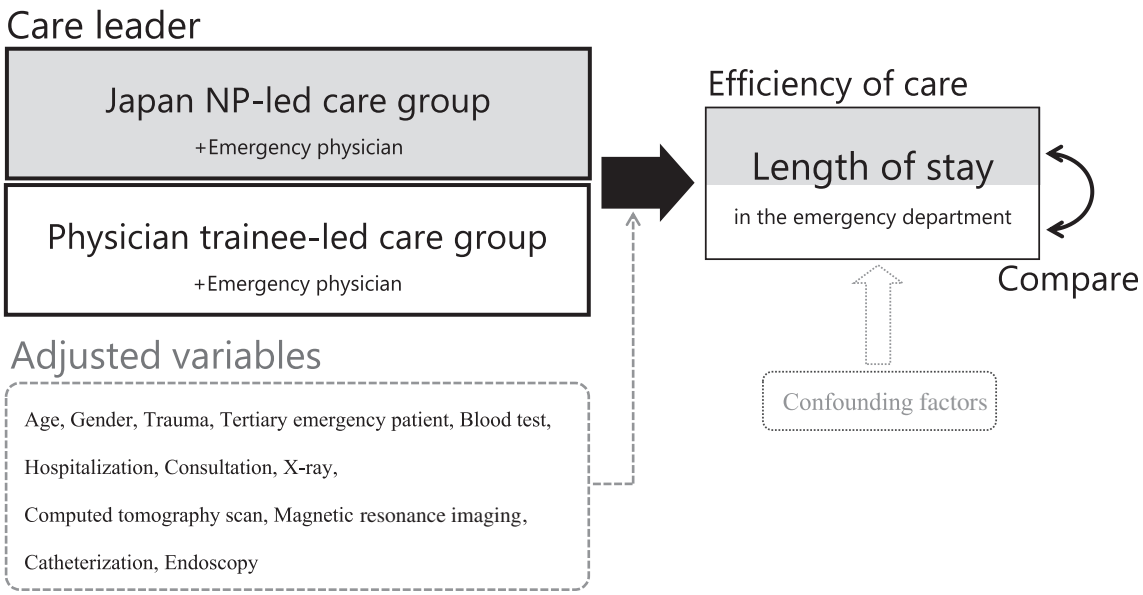

FIGURE 1 The conceptual framework of this study

2.2 | Participants

Key inclusion criteria were that patients be transferred to the secondary ED by ambulance during the day shift (8:30 to 17:15). The reasons for these two criteria were first, that the ED at the target facility only accepted patients transported by ambulance. Second, the Japan NP worked the day shift, so participants were limited to patients transported during the day shift to control for confounding variables due to differences in work shift. We also excluded patients transferred on weekends and holidays for similar reasons.

2.3 | Setting

This study was conducted in a medical institution with about 450 beds that received about 6000 emergency transports per year in western Tokyo. Four Japan NPs were enrolled at the target facility. At the time of the study, the target facility's secondary ED accepted emergency patients 24 h a day, with one Japan NP working as an attendant during the day shift on weekdays. The Japan NP care model at the target facility is a collaborative model focusing on managing patients in a secondary ambulance service. Japan NPs and physician trainees involved in care under the instruction and supervision of emergency physicians shared patient information with emergency physicians at every step. Furthermore, Japan NPs and physician trainees provided medical care to patients under the instruction or supervision of emergency physicians on an ordering system that was approved and laid out by the emergency physicians. The assignment of patients was determined by chance, based on the rotation system of the medical team in the ED, and not on the patients' disease or condition. According to the rules in the ED, the Japan NP was allowed to see more than one patient, while the physician trainee was limited to one patient at a time. There was no waiting time or triage, as patient care – led by an NP or physician trainee – starts upon arrival. Two nurses who were residents and in charge of the EDs worked with the Japan NP and physician trainee during the day shift.

2.4 | Data collection

The data for this study were collected from medical records. The records were compiled by the Japan NP and physician trainee under the supervision of emergency physicians. Electronic medical records are used by medical professionals as well as administrative and accounting staff. We extracted data on patients' characteristics: age; gender; their admission time to the ED; the presence of trauma, testing, and medical care; the discharge time from the ED; the number of tertiary emergency patients at the time of the participants' arrival; and consultations with other departments. The data were entered into a research dataset and verified by the co-authors for transcription errors to ensure reliability.

2.5 | Ethics considerations

This study received ethical approval from the Institutional Review Board of the National Hospital Organization Disaster Medical Center (no. 2018–24) and the Research Ethics Committee of Faculty of Medicine, University of Yamanashi (no. 2072). Informed consent was obtained through a form on the hospital's website. No participants refused to participate.

2.6 | Measurements

2.6.1 | Length of stay

The length of stay in the ED was calculated as the difference between the time the patients were admitted and discharged from the ED in minutes. The admission time of patients was recorded by the ambulance team and entered as the reception time in the patients' medical records.

2.6.2 | Care leader

Those who performed the following initial practices were deemed to have led the care: clinical reasoning, differential diagnosis, test selection, interpretation of test results, tentative diagnosis, and decision-making on the course of treatment in the ED. Japan NPs had a rigorous checklist for patients assigned to initial care for annual activity reports to the hospital. We classified care leaders based on the checklist, and reviewed the medical records with the researcher and the Japan NP to verify the classification.

The Japan NP had 11 years of nursing experience and 3 years of Japan NP experience, and was assigned to the ED for the period under study. The physician trainee was licensed to practice medicine as a physician for less than 2 years and was in charge of the ED during the rotation period. On average, three physician trainees worked in the ED per rotation. If the ED became too crowded, physician trainees were in charge of outpatients, along with Japan NPs. When a Japan NP was off duty or absent, the physician trainee would offer care on behalf of the Japan

NP. The work and thinking processes of the Japan NP and physician trainee were almost identical (Table 1).

2.6.3 | Other factors related to length of stay

For factors related to the length of stay, based on earlier research, we examined care leader type (Dehon et al., 2015; Gill et al., 2018); patients' age and gender (Becker et al., 2019; Gill et al., 2018); whether they received clinical tests test including X-ray, computed tomography (CT) scan, magnetic resonance imaging (MRI; Gill et al., 2018), and blood tests (Holland et al., 2005); catheterization (Khot et al., 2007), endoscopy, and trauma (Becker et al., 2019) characteristics; hospitalization (i.e., return home or hospitalization, including transfers to other hospitals); the number of consultations with other departments; and the number of tertiary emergency patients when the participants arrived at the hospital. The number of tertiary emergency patients may affect the length of stay of secondary emergency patients (Kasagi et al., 2009) as they require hospitalization and human resources, such as physicians and nurses, and are given priority over secondary emergency patients for testing. Therefore, secondary emergency patients often wait longer for tests than tertiary emergency patients.

TABLE 1 Work and thinking process flow of the Japan nurse practitioner and physician trainee roles in the emergency department

Patients	Japan NP (nurse practitioner)	Physician trainee
Entering emergency department	Interview, physical examination, vital signs measurement	
↓	Clinical reasoning	
	Differential diseases	
	Selection of necessary tests, explanation of tests	
	Test order (approval by emergency physicians)	
	Interpretation of test results	
	Provisional diagnosis(Japan NP)/ Diagnosis (Physician trainee)	
	Treatment and medication (approval by emergency physicians)	
	Consults with other departments	
Leaving emergency department	Decision to admit, coordination of hospitalization	
	Under the physician's instruction	Under the physician's supervision

2.7 | Statistical analyses

We calculated descriptive statistics, including a simple tabulation for each variable and mean (± standard deviation) of the length of stay. For the tertiary emergency patient variable, the number of participants was eight; therefore, it was reclassified to the level of 2 or more, together with two participants. Similarly, for the consultation variables, six participants were reclassified to a level of 3 or more by combining three and four cases. For each variable, we performed *t* tests for the length of stay in the Japan NP and physician trainee groups. The correlations between the variables were calculated using Spearman's correlation coefficients, the tetrachoric correlation coefficient (Pearson, 1900), and the point-biserial correlation coefficient (Sheskin, 2011) depending on the type of scale. In addition, simple linear regression analyses were performed with the length of stay as the dependent variable and the factors related to the length of stay as the independent variables. Further, a multiple linear regression analysis was performed. For the selection of independent variables in Model 1, we built a model excluding variables that were strongly correlated with the blood test variables. For Model 2, only the trauma variables that were found to be significantly correlated with the blood test variables were added as independent variables. Model 3 was constructed by selecting the hospitalization variable instead of the trauma variable. Model 4 was constructed by selecting CT scan instead of the trauma variable, and Model 5 was constructed by selecting X-ray instead of the trauma variable. The level of significance for *p*-values was taken as <0.05. Stata version 15 (Stata Corp LLC, Lakeway, TX, USA) was used for all statistical analyses.

3 | RESULTS

3.1 | Participants' characteristics and the comparison of length of stay in the Japan NP- and physician trainee-led care groups

The number of participants analyzed was 1419, and the patients' length of stay ranged from 6 to 486 min (mean = 142.9, standard deviation = 68.6 min; median = 134.0, interquartile range = 88 min).

Table 2 provides a comparison of the length of stay in the two groups by participant characteristics. Specifically, 52.3% of the participants were men, and 47.7% were

women. The patients' mean age was 63.9 (SD = 23.4) years. Further, 53.8% of the participants received NP care, and 46.2% did not; 62.9% had no traumatic injury, and 37.1% had traumatic injury; and for 1052 participants (74.1%) there were no tertiary emergency patients when they arrived at the hospital. The hospitalization variables were 50.0% for both returning home and hospitalization, including transfer to another hospital. There were 340 patients (24.0%) who did not see other departments, and most (88.6%) had blood tests done. By contrast, 0.2% had an endoscopy, 8.9% received an MRI test, and 0.4% received a catheterization (i.e., cardiovascular or cerebrovascular catheter). A *t* test was conducted for each level of participant characteristics to check whether there was a difference in the length of stay between the two groups. No significant differences were found between the Japan NP and the physician trainee groups at any level.

3.2 | The relationship between the length of stay and care leader

Correlations between the independent variables were examined to avoid multicollinearity in the multiple

TABLE 2 Comparison of LOS in Japan NP-led care group and physician trainee-led care group by participant characteristics ($n = 1419$)

				Japan NP LOS (min)			Physician trainee LOS (min)			
Variables		***n***	**%**	***n***	**Mean**	**SD**	***n***	**Mean**	**SD**	***p***
Age[a]	Year	1419	100.0	763	64.1	22.9	656	63.5	23.9	0.314
Gender	Female	677	47.7	359	144.3	68.2	318	139.9	64.3	0.193
	Male	742	52.3	404	142.5	71.4	338	144.9	69.8	0.323
Trauma	Non-trauma	892	62.9	471	145.3	66.2	421	147.6	66.8	0.298
	Trauma	527	37.1	292	140.2	75.5	235	133.1	67.0	0.132
Tertiary emergency patient[b]	0	1052	74.1	551	141.6	70.8	501	141.3	65.1	0.466
	1	308	21.7	180	144.3	63.0	128	146.9	73.2	0.366
	More than 2	59	4.2	32	167.1	82.0	27	142.9	76.3	0.131
Hospitalization	Return home	710	50.0	381	126.3	63.7	329	123.3	65.2	0.267
	Hospitalization	709	50.0	382	160.3	71.6	327	161.7	63.6	0.390
Consultation[c]	0	340	24.0	129	125.9	61.2	211	132.6	55.1	0.147
	1	806	56.8	455	137.1	69.2	351	138.7	69.3	0.372
	2	225	15.9	147	167.2	71.3	78	174.3	74.6	0.244
	More than 3	48	3.4	32	192.0	59.7	16	198.1	59.6	0.370
X-ray	Without	204	14.4	105	104.3	65.7	99	97.2	59.1	0.208
	With	1215	85.6	658	149.5	68.5	557	150.5	65.4	0.404
CT scan	Without	489	34.5	252	112.7	58.5	237	110.5	58.4	0.343
	With	930	65.5	511	158.5	70.1	419	160.5	56.1	0.323
MRI	Without	1292	91.1	696	138.2	67.5	596	136.0	61.6	0.268
	With	127	8.9	67	196.5	72.0	60	206.8	84.5	0.230
Blood test	Without	162	11.4	70	79.5	39.0	92	84.2	51.4	0.262
	With	1257	88.6	693	149.8	69.1	564	152.0	64.6	0.284
Catheterization	Without	1413	99.6	760	143.6	69.9	653	142.6	67.2	0.396
	With	6	0.4	3	83.3	39.3	3	110.7	51.4	0.253
Endoscopy	Without	1391	98.0	748	142.9	70.1	643	142.0	66.7	0.407
	With	28	2.0	15	166.1	53.8	13	164.5	89.0	0.476
t test										

t-test:, not in the table.

Abbreviations: CT, computerized tomography; LOS, length of stay; MRI, magnetic resonance imaging; *n*, number; NP, nurse practitioner; SD, standard deviation.

[a]The mean and standard deviation of the variables themselves are shown.

[b]Number of tertiary emergency patients when the subjects arrived at the hospital.

[c]Consultation = number of consultations with departments other than the emergency department.

TABLE 3 Correlation coefficients between variables ($n = 1419$)

Variables		Length of stay (min)	Care leader	Age	Gender	Trauma	Tertiary emergency patient	Hospitalization	Consultation	X-ray	CT scan	MRI	Blood test	Catheterization
Care leader	Physician trainee/Japan NP	0.006												
Age	Year	0.244**	0.013											
Gender	Female/male	0.010	0.022	−0.069**										
Trauma	Non-trauma/trauma	−0.066*	0.041	−0.259**	−0.119**									
Tertiary emergency patient[a]	Person	0.034	0.039	−0.020	0.01	−0.044								
Hospitalization	Return home/hospitalization	0.262**	0.003	0.259**	0.116*	−0.192**	−0.052							
Consultation	Case	0.202**	0.178**	0.103**	−0.012	0.154**	−0.004	−0.018						
X-ray	Without/with	0.251**	0.037	0.299**	0.021	−0.010	−0.050	**0.754****	0.092**					
CT scan	Without/with	0.331**	0.053	0.206**	0.085	−0.078	−0.001	0.364**	0.188**	0.223**				
MRI	Without/with	0.267**	−0.014	0.898**	0.028	−0.275**	−0.001	0.374**	0.073**	0.183*	0.475**			
Blood test	Without/with	0.318**	0.156**	0.414**	0.107	**−0.596****	−0.034	**0.860****	0.033	**0.552****	**0.581****	0.427**		
Catheterization	Without/with	−0.044	−0.032	0.027	**1.000***	**−1.000***	0.024	**1.000**	0.001	**1.000**	−0.136	0.130	**1.000**	
Endoscopy	Without/with	0.046	−0.002	0.043	0.126	**−0.513****	0.052	0.407**	0.023	**1.000***	−0.233*	−0.179	**1.000**	**−1.000**

Note: Correlation coefficients between independent variables were examined in order to avoid multicollinearity in multiple regression analysis.
Continuous variables and continuous variables were calculated Spearman's correlation coefficient. The continuous and binary variables were calculated Point-biserial correlations coefficients.
Binary variables and binary variables were calculated Tetrachoric correlation coefficient. *$p<0.05$, **$p<0.01$, bold = an absolute value of 0.500 or more.
Abbreviations: CT, computerized tomography; MRI, magnetic resonance imaging; *n*, number; NP, nurse practitioner,
[a]Number of tertiary emergency patients when the subjects arrived at the hospital.

TABLE 4 Association of LOS in the ED with care leader ($n = 1419$)

			Crude			Adjusted Model 1			Model 2		
				95% CI			95% CI			95% CI	
Variables		***n***	**Regression coefficient**	**Lower bound**	**Upper bound**	**Regression coefficient**	**Lower bound**	**Upper bound**	**Regression coefficient**	**Lower bound**	**Upper bound**
Care leader	Physician trainee	656	Reference			Reference			Reference		
	Japan NP	763	0.88	−6.29	8.05	−6.81*	−13.35	−0.26	−6.90*	−13.44	−0.36
Age	Year	1419	0.66**	0.51	0.81	0.23**	0.08	0.38	0.25**	0.10	0.41
Gender	Female	677	Reference			Reference			Reference		
	Male	742	1.33	−5.82	8.49	0.02	−6.42	6.46	0.45	−6.00	6.91
Tertiary emergency patient[a]	Person	1419	5.52	−1.07	12.12	7.36*	1.44	13.28	7.65*	1.72	13.57
Endoscopy	Without	1391	Reference			Reference			Reference		
	With	28	22.89	−2.78	48.56	13.85	−9.23	36.93	15.69	−7.46	38.84
Consultation[b]	Case	1419	20.20**	15.42	24.98	17.94**	13.46	22.43	17.14**	12.57	21.71
MRI	Without	1292	Reference			Reference			Reference		
	With	127	64.18**	52.11	76.25	53.12**	41.82	64.42	54.11**	42.76	65.45
Blood test	Without	162	Reference			Reference			Reference		
	With	1257	68.62**	57.96	79.27	56.54**	45.38	67.70	58.82**	47.38	70.25
Trauma	Without	892	Reference						Reference		
	With	527	−9.37*	−16.75	−1.99				6.53*	−0.73	13.79
Hospitalization	Return home	710	Reference								
	Hospitalization	709	35.97**	29.07	42.87						
CT scan	Without	489	Reference								
	With	930	47.77**	40.67	54.86						
X-ray	Without	204	Reference								
	With	1215	49.10**	39.24	58.97						
Catheterization	Without	1413	reference								
	With	6	−46.11	−101.15	8.92						

Note: Crude refers to simple linear regression analysis, and Adjusted to multiple linear regression analysis; the models that did not include all variables that were correlated above 0.5 at the same time. Model 1: $R^2 = 0.20$, VIF = 1.01 ~ 1.24; Model 2: $R^2 = 0.21$, VIF = 1.01 ~ 1.30, *$p<0.05$, **$p<0.01$.

In Table S1, we show that in Model 2, replacing trauma with either hospitalization, CT scan, or X-ray variables did not change the sign of the care leader's coefficients.

Abbreviations: CI, confidence interval for regression coefficient; CT, computerized tomography; ED, emergency department; LOS, length of stay; MRI, magnetic resonance imaging; NP, nurse practitioner.

[a]Number of tertiary emergency patients when the subject arrives at the hospital.

[b]Consultation = number of consultations with departments other than the emergency department.

regression analysis. The variables that had a significant correlation with the length of stay were age, trauma, hospitalization, consultation, and X-ray, CT scan, MRI, and blood tests. The correlations ranged from −0.066 ($p < 0.05$) to 0.331 ($p < 0.01$; Table 2).

To explore the relationships between the length of stay and each variable, a simple linear regression analysis was performed using the length of stay as the dependent variable. No significant relationship was found between the length of stay and care leader (unstandardized coefficient: 0.88; 95% confidence interval [CI]: −6.29 to 8.05). The variables with significant associations were age, consultation, MRI, blood test, trauma, hospitalization, CT scan, and X-ray (Table 3).

A multiple linear regression analysis was performed to explore the relationship between the length of stay and care leader after adjusting for other variables. To avoid multicollinearity in the multiple regression analysis, we built the models such that no variables with absolute values of correlation coefficients greater than 0.500 were included concurrently. The length of stay was the dependent variable, and the independent variables were care leader, age, gender, tertiary emergency patients, endoscopy, consultation, MRI, and blood test.

The results of the multiple linear regression analysis demonstrated that there was a significant relationship between the length of stay and the care leader. The patients' length of stay was significantly shorter by 6 min in the Japan NP group, compared with the physician trainee group (−6.81; −13.35 to −0.26). The other significant variables were age (0.23; 0.08 to 0.38), tertiary emergency patients (7.36; 1.44 to 13.28), consultation (17.94; 13.46 to 22.43), MRI (53.12; 41.82 to 64.42), and blood test (56.54; 45.38 to 67.70; Table 4). To check for robustness of the sign of the care leader's coefficients, we constructed Model 2 with the addition of trauma; however, the sign of the care leader coefficients did not change. Additionally, we demonstrated that, in Model 2, replacing trauma with hospitalization, CT scan, or X-ray, the variables did not change the sign of the care leaders' coefficients (Table S1 in the Supporting Information).

4 | DISCUSSION

4.1 | Participants' characteristics

The assignment of patients was determined by chance based on the rotation system of the medical team in the ED, and not on the basis of the patients' disease or condition. The results of the analysis showed that there were no significant differences between the Japan NP and physician trainee groups at all levels. These findings suggest that Japan NPs and physician trainees were providing initial care to a population of secondary emergency patients with generally similar characteristics, although patients' diseases and severity of illness were not taken into account.

4.2 | The relationship between the length of stay and care leader

This study demonstrated that patients' length of stay was significantly shorter by 6 min in the Japan NP group compared with the physician trainee group. In any of the multiple regression models in which trauma, hospitalization, CT scan, and X-ray were entered, the care leaders' coefficient remained the same, and it was negative. Considering that Japan NPs sometimes saw more than one patient whereas physician trainees only saw up to one patient and that the median length of stay was 134.0 min, this time difference suggests that the medical care led by Japan NPs is not inferior to physician trainee-led care in terms of time spent. To our knowledge, this was the first study to demonstrate the outcome of a Japan NP-led care in a secondary ED in Japan. However, all patients received care at a secondary ED during weekday shifts.

Previous studies have asserted that NPs have a beneficial effect on patients' length of stay. A study conducted in the ED of a small city found that the median length of stay of the NP-provided patient group was 77 min, compared with the 174 min of the NP and emergency physician-provided group (Steiner et al., 2009). Further, a cohort study in the ED of a community hospital in an urban area revealed the following: 85 ± 56 min in the physician group and 65 ± 42 in the emergency NP group (van der Linden et al., 2010). A study of outpatients in the ED with levels ranging from non-urgent to potentially life-threatening revealed a median length of stay of 94 min in the NP-provided care group and 170 min in the patient group who received conventional care (Jennings et al., 2008). Although the results cannot be fully generalized because our study was conducted in Japan, and NPs' work styles and work contents may differ across countries, our findings support previous studies in that NP-provided care was associated with shortened length of stay among ED patients.

Concerning the method, some previous studies adjusted the bias of patients' severity and urgency by stratifying the NP-provided medical care group and physicians' medical care group by triage category (Jennings et al., 2008; Middleton et al., 2011; Steiner et al., 2009). Unlike previous studies, to address these biases, the current study limited participants to patients who were

treated at a secondary ED. Additionally, we adjusted for patients' characteristics and whether they received tests in the multivariate analyses, which still revealed that the NP-led group had a significantly shorter length of stay than the physician trainee-led group.

Previous studies also suggest that NP-provided care is not inferior to physician-provided care. A case–control study of 725 emergency outpatients who came home with orthopedic diseases demonstrated that the median length of stay in the conventional system without NP was 137 min and 125 min with NP, which was non-significant (Considine et al., 2006). Steiner et al. (2009) found that the length of stay was 123 min for the emergency physician-provided patients and 125 min for those provided with care by the emergency physicians and NP, which was non-significant ($p = 0.13$). By contrast, in a study investigating patients who returned home after visiting the ambulatory care clinic, the median length of stay for the physician-provided and NP-provided groups was 143 and 156 min, respectively, which amounted to a significant difference (Middleton et al., 2011). In one study that evaluated physicians' and NPs' care for patients with minor injuries in an emergency facility, the average care time of the physician group was 12 min shorter than that of the NP group (Byrne et al., 2000). In these previous studies, the NP-provided group had a longer length of stay than the physician-provided group in the ED, which contrasts with our findings. We cannot deny the existence of publication bias—that only favorable results concerning NPs are published. However, our study suggests that there is no disadvantage to patients' length of stay by receiving care from a Japan NP instead of a physician.

The length of stay in EDs is defined by performance in four processes: medical care in the ED, medical care of specialized medical departments, ward coordination, and movement. In particular, medical care in the ED includes the time related to interviews, physical examinations, judgment and implementation of various tests, interpretation of test results, provisional diagnosis, consultation with other departments, and treatment policy decisions. Therefore, the length of stay reflects not only the power of the department in charge but also the speed of cooperation among various departments within the hospital.

The results of our study, adjusted for patients' characteristics and whether medical tests were conducted, suggest that care led by Japan NPs could shorten patients' length of stay. As illustrated in Table S1, the coefficients' direction was negative when the independent variables were care leader and consultation variables. The Japan NP group tended to spend about 4 min less in the ED than the physician trainee group concerning consultations with other departments. The shorter length of stay may be due to the relationship between other departments and other factors depending on the skill and experience of the individual Japan NP and their ability to coordinate. This is probably because Japan NPs collaborate with various departments in the hospital more efficiently than physician trainees. Japan NPs are also more likely to have more years of hospital employment than physician trainees, and they may be more familiar with the hospital system and culture. The results suggest that Japan NPs are not inferior to physician trainees in terms of the time spent by them to manage patients.

A previous study compared NPs and nurses and examined patients' length of stay in the ED (Allerston & Justham, 2000). In that study, the mean length of stay of patients with NP-led care was 73 min, while that of patients with nurse-led care was 98 min. The NPs could assess the test order, interpret test results, and provide medical care (including triage). Certainly, nurses may reduce patients' length of stay in EDs by improving manuals, operations, and triage skills. However, NPs have better ability to understand pathological conditions, provide necessary tests, and provide predictive care than nurses, and they are often involved in medical care. Therefore, it was considered that they are directly involved in decreasing patients' length of stay.

Another advantage of introducing Japan NPs in the ED is that the quality of medical care is improved. For example, NPs can lead medical care for patients with mild conditions, and physicians can focus on treating patients with more severe and complicated diseases. In recent years, there has been a shortage of emergency physicians owing to the uneven distribution of physicians in Japan (Matsumoto et al., 2011), and a work style reform law has promoted restrictions on physicians' ability to work overtime (Ministry of Health, Labor, and Welfare, 2019). Consequently, Japan NPs reduce emergency physicians' work-related burdens. In addition, NPs enable smoother collaboration and task-sharing between physicians and nurses. The introduction of Japan NPs will lead to investment in hospital organizations and benefit patients, families, and team care (Kutzleb et al., 2015). Thus, policymakers should consider introducing Japan NPs in secondary emergency outpatient care to address the limitations mentioned above in medical settings.

4.3 | Strengths

The strengths of this study are the number of participants and the use of objective medical record data. We assessed

one Japan NP at one target facility; therefore, the internal validity is maintained. In addition, we can compare our results to those of previous studies conducted overseas.

4.4 | Limitations

As this was a retrospective survey, it lacked accuracy and completeness of the data, owing to differences in record-keeping. Further, it is possible that transcription errors may have occurred during data collection. Patients' discharge time was recorded in the medical record by the emergency nurses. Moreover, the external generalizability of our results is limited since our data reflect the practice of one Japan NP working at one site. Patients were admitted during the day on weekdays; therefore, data concerning nighttime and weekend/holiday cases were not included. The results should thus be generalized with caution. Further, a multivariate analysis was performed using nine variables. The coefficient of determination (R^2) of the multiple linear regression analysis model in this study was 0.20. The remaining 80% of the length of stay was explained by other factors that were not surveyed in this study. In addition, we were unable to investigate the background of the physician trainees and emergency physicians, including their years of experience.

5 | CONCLUSION

The patients' length of stay was significantly shorter by 6 min in the Japan NP group compared with the physician trainee group. Although not conclusive, the time difference suggests that Japan NPs are not inferior to physician trainees in terms of the time spent to manage patients.

ACKNOWLEDGMENTS

Our special thanks go to the patients who participated in the study. Special thanks are also extended to the staff members of the Department of Health Sciences, University of Yamanashi, for their any suggestions and advice to brush up on this study. We also thank Editage (www.editage.com) for English language editing. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

AUTHOR CONTRIBUTIONS

Keiichi Uranaka designed the study, developed and managed the main database, interpreted the analysis, and drafted the paper; Hitoshi Takaira, Ryoji Shinohara., and Zentaro Yamagata contributed to the design of the study and the interpretation of the data and critically revised the manuscript for important intellectual contents. All authors read and approved the final manuscript.

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How to cite this article: Uranaka, K., Takaira, H., Shinohara, R., & Yamagata, Z. (2021). Comparison of Japan nurse practitioner-led care and physician trainee-led care on patients' length of stay in a secondary emergency department: A retrospective study. *Japan Journal of Nursing Science*, *18*(4), e12437. https://doi.org/10.1111/jjns.12437