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## Brief Communication

# Physical restraints in intensive care units: a national questionnaire survey of physical restraint use for critically ill patients undergoing invasive mechanical ventilation in Japan

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**Aims:** Physical restraints are often used for patients undergoing mechanical ventilation to protect important medical equipment. However, they have adverse physical and psychological effects and could pose ethical hazards. Physical restraint use varies by country, but so far there is little understanding of the frequency of physical restraint use among intensive care unit (ICU) patients in Japan. The present study aims to describe the frequency of physical restraint use among Japanese patients undergoing mechanical ventilation. Additionally, it attempts to verify the hypothesis that insufficient human resources have increased the frequency of physical restraints.

**Methods:** We undertook a cross-sectional online open anonymous survey of ICU nurses using a self-administered questionnaire to examine the use of physical restraints for patients undergoing invasive mechanical ventilation in Japan.

**Results:** We obtained 175 responses, of which 46 were excluded. Of the respondents, 43% reported that physical restraints were used for more than 75% of mechanically ventilated patients. Intensive care units with a higher frequency of physical restraint use had a significantly greater number of beds per nurse compared to those with a lower frequency; however, after adjusting for the number of beds in the ICU and hospital type in a logistic regression analysis, the number of beds per nurse was no longer significantly related to the use of physical restraints.

**Conclusions:** Physical restraints are commonly used among patients undergoing mechanical ventilation in Japan. A systematic approach to reducing physical restraint use among mechanically ventilated patients is needed.

**Key words:** Behavior control, critical care, intensive care unit, mechanical ventilation, nursing

## INTRODUCTION

PHYSICAL RESTRAINTS ARE often used for patients undergoing mechanical ventilation to protect important medical equipment (e.g., tracheal tubes). However, they

have adverse physical and psychological effects and may pose ethical hazards. For example, physical restraints are associated with increased risks of delirium<sup>1,2</sup> and post-traumatic stress disorder.<sup>3</sup>

Physical restraint use varies by country,<sup>4</sup> but so far there is little understanding of the frequency of physical restraint use among intensive care unit (ICU) patients in Japan. Therefore, we surveyed ICU nurses to describe the perceived frequency of physical restraint use among Japanese patients undergoing mechanical ventilation. Additionally, physical restraint use among mechanically ventilated patients is known to be influenced by factors such as patient characteristics, devices used, sedation management, and human resources.<sup>5</sup> We attempted to verify our hypothesis

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that the high proportion of beds in private rooms and insufficient human resources have increased the frequency of physical restraints.

## METHOD

**WE UNDERTOOK** A cross-sectional, online open anonymous survey of ICU nurses in Japan. We included only ICUs with a patient-to-nurse ratio of no more than 2 to represent practice for critically ill patients with mechanical ventilation.

The research team, including five clinical nurses and two nurse educators, developed a seven-item physical restraint-related questionnaire through an interactive process among the research team. Before undertaking the survey, we distributed it to 17 paired respondents who were nurses working in 17 ICUs and estimated the inter-rater reliability using weighted Cohen's kappa, which exceeded 0.5 on each item, indicating moderate to excellent inter-rater agreement.

The survey was completed online using SurveyMonkey.com over 10 days beginning on May 11, 2018. The link to the questionnaire was placed on the website and social network services of the Japanese Society of Education for Physicians and Trainees in Intensive Care (JSEPTIC). To increase the response rate and reflect clinical practice across every ICU in Japan, we posted a notification of the survey to the electronic mailing list of the JSEPTIC nursing department and the Japanese certified nurse in intensive care association.

The web-based survey was provided after participants were informed of the survey length, analysis process, and purpose of the study. All questions were considered essential to clarify our hypotheses and thus were designed as mandatory; as a result, respondents could not submit the survey until completion of all questions. Physical restraint was defined as the use of mechanical wrist restraint.

To avoid multiple responses from the same ICU, respondents needed to enter their institution's name. When we obtained duplicate responses from the same ICU, we excluded all responses except the first. Thus, only one response corresponded to each ICU.

The data were described as number and percentage or as median and interquartile range. Demographic characteristics for ICUs with physical restraint use in more than 75% of patients undergoing mechanical ventilation and other ICUs were compared using Fisher's exact test for categorical variables or the Mann–Whitney *U*-test for continuous variables. To assess factors associated with ICUs with higher use of physical restraint, we used multivariable logistic regression, and reported results using odds ratios and 95% confidence intervals. Statistical analyses were carried out with EZR (Saitama Medical Center, Jichi Medical University, Japan).

## RESULTS

**WE OBTAINED** 175 responses. Of these, 46 respondents were excluded (23 because of duplicate data, 16 because respondents were not working in ICUs, and seven because of incomplete data). Thus, 129 respondents from separate ICUs were analyzed.

Table 1 shows the descriptive statistics. Three quarters of respondents were certified nurses, and one quarter were working in university hospitals. Table 2 shows perceived physical restraint practice for patients undergoing mechanical ventilation. Of the 129 respondents, 43% reported that

**Table 1.** Characteristics of 129 intensive care units and nurses in Japan who responded to a survey regarding the use of physical restraints for critically ill patients undergoing mechanical ventilation

Variable	<i>n</i>	% or range
Years of intensive care experience		
<5	8	6.2
5–9	38	29.5
10–14	58	45.0
15–19	21	16.3
>19	4	3.1
Certification		
None	26	20.2
Certified nurse	100	77.5
Certified nurse specialist	3	2.3
Hospital		
University hospital	30	23.3
General hospital	99	76.7
ICU setting		
Closed ICU	8	6.2
Semiclosed ICU	32	24.8
Semi-open ICU	43	33.3
Open ICU	46	35.7
Private rooms for ICU beds		
<25%	60	46.5
25–49%	33	25.6
50–75%	21	16.3
>75%	15	11.6
Type of ICU		
Emergency ICU	24	18.6
Other ICU	105	81.4
No. of beds in ICU†	8	(6–12)
No. of nurses during daytime†	8	(6–11)
Number of beds per nurse†	1.11	(0.86–1.40)
Written protocol or guideline		
Yes	50	38.8
No	79	61.2

†Values are median (interquartile range).

**Table 2.** Frequency of physical restraint of critically ill patients in Japan undergoing mechanical ventilation

Variables	<i>n</i>	%
Physical restraint of patients		
Daytime, % of patients		
<25	24	18.6
25–49	27	20.9
50–75	22	17.1
>75	56	43.4
Night-time, % of patients		
<25	12	9.3
25–49	20	15.5
50–75	27	20.9
>75	70	54.3
Physical restraint of patients awake, calm, and responding to commands		
Daytime, % of patients		
<25	64	49.6
25–49	21	16.3
50–75	20	15.5
>75	24	18.6
Night-time, % of patients		
<25	40	31.0
25–49	25	19.4
50–75	21	16.3
>75	43	33.3
Physical restraint of comatose patients		
Daytime, % of patients		
<25	87	67.4
25–49	16	12.4
50–75	18	14.0
>75	8	6.2
Night-time, % of patients		
<25	82	63.6
25–49	18	14.0
50–75	18	14.0
>75	11	8.5

physical restraints were used for more than 75% of patients undergoing mechanical ventilation in the daytime. Furthermore, 31% of respondents indicated that physical restraints were used in <25% of patients who were awake and calm during the daytime, while 34% reported that physical restraints were used in more than 50% of such patients. More than half of ICUs (61%) did not use written protocols or guidelines for physical restraints.

Table 3 shows the comparison of characteristics between ICUs that used physical restraints for <75% of patients (*n* = 73, 57%) and those that used restraints for 75% or more of patients (*n* = 56, 43%). The latter group reported a

significantly greater median (25th–75th percentile) number of beds per nurse and number of beds in ICU than did the former (1.19 [0.92–1.45] versus 1.00 [0.86–1.33], *P* = 0.043; 10 [7.75–13.25] versus 8 [6.00–10.00], *P* = 0.01). However, after adjusting for the number of beds in the ICU and hospital type in a logistic regression analysis, the number of beds per nurse was no longer significantly related to use of physical restraints (odds ratio, 2.18; 95% confidential interval, 0.76–6.20; *P* = 0.15; Table S1).

## DISCUSSION

**T**O OUR KNOWLEDGE, this is the first study to examine physical restraint use among patients undergoing mechanical ventilation in Japanese ICUs. We found that more than 40% of the surveyed ICUs used physical restraints frequently (for >75% of patients) for these patients. However, because of methodological differences, it is difficult to compare the frequency of physical restraint use with previous reports. One survey in France using a similar methodology showed that, of 130 ICUs, 57% reported that more than 75% of mechanically ventilated patients were physically restrained.<sup>6</sup> These findings suggest that physical restraints are less frequently used in Japan than in France; however, this may be due to differences in human resources between these countries. In fact, the French study<sup>6</sup> found that the median patient-to-nurse ratio was 2.8, meaning that there were far fewer nurses in French ICUs than in Japanese ones.

We examined how the proportion of beds in private rooms and human resources influenced physical restraint use among mechanically ventilated patients, but we found that the number of beds per nurse, proportion of beds in private rooms, and use of protocols/guidelines were unrelated to the frequency of physical restraint use. It remains controversial whether the patient-to-nurse ratio influences the use of physical restraints; for instance, two prospective observational studies showed that the frequency of physical restraint use was not associated with ICU patient-to-nurse ratio.<sup>5,7</sup> We cannot draw conclusions regarding the effect of the patient-to-nurse ratio on physical restraint use in this study for many reasons; for instance, we did not measure sedation management strategies. Additionally, we included only units with a patient-to-nurse ratio of a maximum of 2, which could have affected our results.

The frequency of physical restraint use varied among the study ICUs. This variation indicates that there could be methods of reducing physical restraint use in ICUs. For example, physical restraint use could be influenced by depth of sedation, time of day (daytime or night-time), and a number of changeable factors we did not consider (e.g., nurses' knowledge about restraints, beliefs of medical staff, and culture).<sup>8</sup>

**Table 3.** Comparison of intensive care units (ICUs) in Japan that use physical restraints, grouped according to use in less or more than 75% of patients undergoing mechanical ventilation

Variable	ICUs where physical restraints are used for <75% of patients, <i>n</i> = 73		ICUs where physical restraints are used for ≥75% of patients, <i>n</i> = 56		<i>P</i> -value
	<i>n</i>	% or range	<i>n</i>	% or range	
University hospital	14	19.2	16	28.6	0.29
Open ICU	30	41.4	16	28.6	0.19
≥50% beds in private rooms	21	28.8	15	26.8	0.85
No. of beds per RN <sup>†</sup>	1	(0.86–1.33)	1.19	(0.92–1.45)	0.04
No. of beds in ICU <sup>†</sup>	8	(6.00–10.00)	10	(7.75–13.25)	0.01
Emergency ICU	11	15.1	13	23.2	0.26
Use of written protocol	31	42.5	19	33.9	0.37

<sup>†</sup>Values are median (interquartile range). RN, registered nurse.

The present web-based self-administered questionnaire has limitations. The response rate cannot be precisely determined because of difficulties in undertaking such a wide-spread web-based, open, anonymous survey. Because of the method of distribution of the questionnaire, there is potential for selection bias. However, survey respondents were working in settings with a broad range of ICU characteristics, including those from different geographical areas, with various numbers of ICU beds, and within different types of hospitals (university versus non-university). Therefore, our findings reflect the current clinical practice from various ICUs in Japan. Additionally, there are possible differences between what respondents reported and their actual practice. This is because, unlike direct observations, a self-administered questionnaire relies on respondents' perceptions.

## CONCLUSION

**T**HIS PRELIMINARY SURVEY revealed that physical restraints are commonly used among patients undergoing mechanical ventilation in Japan. However, physical restraint use varied among ICUs, irrespective of their human resources and proportion of beds in private rooms. A systematic approach to reducing physical restraint use among mechanically ventilated patients is needed.

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## DISCLOSURE

Approval of the research protocol: The protocol for this research project was approved by a suitably constituted Ethics Committee of the University of Tsukuba Hospital and it conforms to the provisions of the Declaration of Helsinki, Approval No. H-29-281.

Informed consent (if applicable): Informed consent was obtained from all respondents.

Registry and registration no. of the study: N/A.

Animal studies (if applicable): N/A.

Conflict of interest: None.

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## APPENDIX 1

### Members of the Japanese Society of Education for Physicians and Trainees in Intensive Care (JSEPTIC) Nursing Research Group

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## SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

**Table S1.** Risk factors for frequent use of physical restraints in intensive care units based on logistic regression analysis