

## [Original Research]

# Comprehensive Attempts to Promulgate Patient-Controlled Analgesia (PCA) in Palliative Care: Fact-finding Study of Cancer Patients and Questionnaire Survey of Healthcare Professionals on Implementing PCA in Real-World Practice

Azumi SAKO,<sup>\*1</sup> Seiya YOSHIDA,<sup>\*2</sup> Yuka YOSHIOKA,<sup>\*3</sup>  
Norihiro KIKUCHI,<sup>\*4</sup> and Hirotochi ECHIZEN<sup>\*5</sup>

<sup>\*1</sup> Department of Pharmacy, National Hospital Organization Kasumigaura Medical Center

<sup>\*2</sup> Department of Pharmacy, Nishisaitama-chuo National Hospital

<sup>\*3</sup> Department of Nursing, National Hospital Organization Kasumigaura Medical Center

<sup>\*4</sup> Respiratory Medicine, National Hospital Organization Kasumigaura Medical Center

<sup>\*5</sup> Department of Pharmacotherapy, Meiji Pharmaceutical University

(Accepted September 13, 2018)

**Abstract:** Use of patient-controlled analgesia (PCA) for cancer pain control has been promulgated slowly in Japan. We aimed to investigate obstacles for dissemination of PCA. We conducted a study on the usage of a PCA device by reviewing medical records at the National Hospital Organization, Kasumigaura Medical Center between July 1, 2008 and December 31, 2017. We also conducted a questionnaire survey of physicians, pharmacists, and nurses about PCA to look for practical obstacles. Of 52 patients with advanced cancer who used PCA, 73% of them reported satisfactory analgesia. Thirty PCA users (58%) were able to manage rescue doses by themselves, and they had significantly ( $p < 0.05$ ) higher probability (53%) of discharge or returning home temporarily compared to those who were unable to manage self-rescue (18%). Patients who managed rescue doses had better performance status and fewer neurological symptoms at baseline compared to those who did not. The questionnaire was returned from 81% of the eligible subjects (10 physicians, 96 nurses, and 8 pharmacists). While nurses handled the majority of trouble associated with PCA, they were less confident about troubleshooting than were physicians. Respondents requested the establishment of institutional criteria of indication (47%), a troubleshooting support system (68%), and an education program (67%) for PCA. PCA was shown to be practicable in palliative care for patients with advanced cancer in a regional hospital. Better performance status and good neurological conditions at baseline were associated with successful PCA. Major obstacles for the implementation of PCA were considered manageable.

**Key words:** patient-controlled analgesia, cancer pain, opioids, quality of life, questionnaire

## INTRODUCTION

Adequate pain control is indispensable for maintaining good quality of life (QOL) in patients with advanced cancer. However, previous studies have shown that cancer analgesia is not necessarily adequately performed in real-world practice.<sup>1)</sup> Proper use of opioids plays a pivotal role in cancer analgesia. Conventional cancer analgesia has been performed with an oral, slow-release formulation of opioids for basic pain control with supplementation of a rapid-release formulation of opioids for counteracting breakthrough pain. In practice, it is not an

easy task to find an individualized dose of opioid for each patient due to large inter-patient variability of the pharmacokinetics and pharmacodynamics of opioids.<sup>2)</sup> In addition, oral opioids for breakthrough pain may not be given at an appropriate timing. However, the advent of a programmable, portable infusion device has made patient-controlled analgesia (PCA) possible.<sup>3)</sup> Using a PCA device, patients can adjust opioid doses more precisely and counteract breakthrough pain by triggering rescue doses by themselves in a more timely way compared to the traditional method. Previous studies have revealed that the implementation of PCA improves the quality of analgesia in patients with advanced cancer,<sup>3, 4)</sup> and that patients are able to return home at least temporarily using a portable PCA device.<sup>5, 6)</sup>

In our hospital, the palliative care team has introduced a mechanical PCA pump device (CADD Legacy<sup>®</sup>)<sup>7)</sup> for

Corresponding author: Azumi Sako, Department of Pharmacy, National Hospital Organization Kasumigaura Medical Center, 2-7-14, Shimotakatsu, Tsuchiura 300-8585, Japan  
E-mail: azumi.sako71@gmail.com

delivery of cancer analgesia since 2008. While patients who utilized the device reported substantial improvement in QOL, since the introduction of PCA, the number of patients using PCA had not increased as expected until 2013. In order to increase the number of patients using PCA, we decided to conduct a fact-finding study to know how the PCA device had been utilized in our hospital and what benefits patients obtained from PCA. In addition, we decided to conduct a questionnaire survey on PCA among physicians, pharmacists, and nurses in order to investigate the practical, psychological, and economic obstacles for implementing PCA in patients with advanced cancer. Here, we report the data obtained from our fact-finding study and questionnaire survey, and discuss approaches to promulgate the implementation of PCA in Japan.

## MATERIALS AND METHODS

### 1. Fact-finding study on the utilization of PCA for cancer analgesia

We reviewed medical records of patients with advanced cancer who utilized PCA between July 1, 2008 and December 31, 2017 at National Hospital Organization Kasumigaura Medical Center. Retrieved information included demographic data, primary site of cancer, analgesic medications (opioids and non-opioid drugs, their formulations and routes of administration), duration of PCA, person who operated the PCA device to deliver rescue doses, concomitant medications for complications, clinical outcome (discharge, temporarily returning home, in-hospital death), trouble associated with PCA, and adverse drug reactions documented by nurses during PCA.

### 2. Questionnaire survey on PCA among healthcare professionals

We sent questionnaires to all full-time physicians, ward nurses, and hospital pharmacists working in our hospital to survey them on various aspects of care for patients who utilized PCA. The questionnaire sheets were filled in anonymously and returned from December 2, 2014 to December 12, 2014. The questionnaire sheet used in the present study is shown in Appendix. Briefly, retrieved information included type of healthcare professional, specialty of physician, skills and experience with PCA, personal attitude to PCA, trouble encountered with implementation of PCA, and comments and expectation regarding PCA. When a respondent gave no response to a particular question, he/she was removed from the total numbers of respondents for that question.

### 3. Ethical issues

The study protocol for the retrospective review of medical records was approved by the institutional ethics committee before the study was begun. The authors considered that the questionnaire survey to medical professionals in the hospital was waived for deliberation in the ethics committee since it was planned to be performed anonymously and the voluntary return of the questionnaire sheets could be substituted for informed consent.

The questionnaire was conducted to improve the quality of cancer analgesia in the institution, and the purpose of the survey was clearly documented on the questionnaire sheets. The present study was conducted in compliance with the guidelines for collection, storage and handling of personal information of patients for healthcare professionals issued by the Ministry of Health, Labour and Welfare, Japan.<sup>8)</sup>

### 4. Statistical analysis

We compared the clinical characteristics between patients who managed rescue doses by themselves and those who did not. When continuous variables were normally distributed, Student's *t*-test was used for analysis. When data were not normally distributed, a non-parametric test (Mann-Whitney *U* test) was employed. For comparisons of frequencies between the two groups, Fisher's exact test was employed. A *p* value < 0.05 was considered statistically significant. Statistical analysis was performed using the free software environment R (version 3.4.3.).

## RESULTS

### 1. Fact-finding survey of PCA

We identified 52 patients who utilized PCA with opioids. When a patient used PCA twice or more in separate occasions during his/her clinical course, the data were counted as one patient. The patients consisted of 14 men and 38 women, all of whom had advanced malignancy. Demographic data and detailed information of the primary organ of malignancy are shown in Table 1. PCA was indicated for only 13% of patients who received opioid parenterally for cancer analgesia during the study period. Patients who utilized PCA constituted only 7% of cancer patients who received opioid analgesia. The numbers of patients who underwent cancer analgesia with a PCA pump ranged from 1 to 12 per year during the study period. No apparent trend was observed in the annual number of patients who used PCA during the study period.

We identified 93 drugs that were utilized by patients receiving PCA. Opioids were the most frequently used analgesic drugs in PCA (57%). Other drugs used with the PCA are shown in Table 1. When a patient received multiple drugs simultaneously or sequentially, the numbers of drugs administered were counted separately.

The median (25 and 75 percentile values) duration of analgesic therapy using the PCA pump was 10 (4 and 18) days. The most frequent route of administration by the PCA pump was subcutaneous injection (*n* = 43), followed by intravenous infusions (*n* = 9; *via* central vein catheter in 4, peripherally inserted central catheter in 2, and peripheral vein in 3).

While 30 patients were able to administer rescue doses by themselves, nurses administered the doses in 17 patients. In the remaining 5 patients, there was no information on whether rescue doses were given and by whom. Sufficient analgesic effect was obtained by PCA in 38 patients (73%) among those who used the device.

**Appendix** The questionnaire sheet used in the present study. The original questionnaire was made in Japanese. That shown below was translated from the original Japanese version in a word-by-word manner.

---

**Your feedback is highly appreciated.**

The palliative care team wishes to promulgate better use of portable PCA pumps for cancer analgesia in our hospital. We are investigating obstacles that may be impeding the use of the PCA device. Please check the appropriate boxes and fill the parentheses. Feedback to this questionnaire will be used only for the present study.

**What is your profession?**

- Physician, expertise ( )  
 Nurse, ward ( )  
 Pharmacist

**How long is your career?**

- 1-4 years  
 5-9 years  
 longer than 10 years

**Do you know about PCA pump?**

- Yes. I used it or recommended it to my patients.  
 Yes, but I've never used it.  
 No.

**Please answer the following 2 questions, if you answered Yes in the previous question.**

**1. What is your impression about PCA.**

- useful  
 not useful  
 equivocal  
 other ( )

**2. Did you experience troubles during PCA?**

- No.  
 Yes.  
 Please specify. ( )

**Do you feel uneasy if your patients use PCA?**

- No.  
 Yes, but I would use it, if it is necessary.  
 Yes. I would rather stay away from it.  
 Yes. I never use it.

**Please tell us the reasons why you feel uneasy about PCA, if you answered Yes in the previous question. (You may check the boxes as much as you want.)**

- I didn't know that it was available.  
 I don't know how to order it.  
 I don't know how to manipulate it.  
 I don't rely on its performance.  
 I am afraid it may cause troubles.  
 I don't think it may benefit patients.  
 I don't know who are eligible patients.  
 I am too busy and have no time for PCA.  
 Others ( )

**Please feedback what the palliative care team can do for promulgating the use of PCA.**

- Nothing  
 Clarify the institutional indication of PCA.  
 Make payable by public health insurance.  
 Clarification of how to order it.  
 Education of how to use it.  
 Promoting patients' awareness.  
 Promoting healthcare staff's awareness.  
 Establishing inter-professional cooperation.  
 Investment of more user-friendly PCA device.  
 Establishing an institutional support system for trouble-shooting.  
 Others ( )

Adverse drug reactions were observed in 22 patients (42%); including somnolence in 13 patients, nausea in 5, deterioration in consciousness level in 4, delirium in 3, and vomiting in 2. Fever, unstable blood pressure, thirst, dysphagia, skin rashes, arrhythmias, skin itchininess, restlessness, and insomnia were observed in one patient each. When a patient developed multiple adverse drug reactions simultaneously or separately, each event was counted separately. Clinical outcomes of the patients after using the PCA pump were as follows: in-hospital death ( $n = 28$ ), continuation of a constant infusion of analgesic agents with syringe pump ( $n = 13$ ), discharge or transfer to other hospital ( $n = 5$ ), discontinuation of PCA and switch to another analgesic method ( $n = 4$ ), and discontinuation of analgesic therapy ( $n = 2$ ).

There were significant differences in many clinical characteristics between patients who were able to manage rescue doses by themselves ( $n = 30$ ) and those were not ( $n = 17$ ) (Table 2). The group capable of self-managing rescue doses had significantly ( $p < 0.05$ ) better performance score (PS) and significantly lower ( $p < 0.05$ ) frequencies of delirium and restlessness before using PCA

than the other group. In contrast, no significant difference in the incidence of somnolence or delirium during PCA was observed between the two groups.

Twenty-one patients who utilized PCA (40% of all PCA users) were discharged or allowed to return home at least temporarily with a portable PCA pump. While 53% ( $n = 16$ ) of patients who managed rescue doses by themselves ( $n = 30$ ) were discharged or allowed to return home at least temporarily, only 18% ( $n = 3$ ) of patients who did not manage rescue dose by themselves ( $n = 17$ ) were able to leave the hospital ( $p < 0.05$ ). Among 5 patients who gave no information about rescue doses, 2 were discharged or allowed to return home temporarily with a PCA device and the remaining 3 patients were not.

We further analyzed the data of the fact-finding survey on the utilization of PCA by dividing them into two groups: those obtained from before the questionnaire survey was conducted in 2014 and those obtained thereafter. Results revealed that the numbers of patients utilizing PCA did not increase before and after the questionnaire survey (5.9 patients/year versus 3.7

**Table 1** Demographic and clinical characteristics of cancer patients using PCA

	Number of patients
Number of patients ( <i>n</i> )	52
Age (mean $\pm$ <i>SD</i> , years)	56 $\pm$ 13
Gender (male/female)	14/38
Primary organ of cancer ( <i>n</i> )	
Uterus	24
Ovary	8
Pancreas	4
Colon	4
Head and neck	4
Lung	3
Stomach	3
Biliary tract	1
Bone and soft tissues	1
Drugs used for analgesia ( <i>n</i> )	
Opioid	
Morphine hydrochloride	44
Fentanyl citrate	5
Oxycodone hydrochloride hydrate	4
Non-opioid	
Haloperidol	27
Mexiletine hydrochloride	7
Octreotide acetate	4
Lidocaine hydrochloride	1
Chlorpromazine	1

*SD* = standard deviation.

patients/year, respectively). Nevertheless, the percentages of patients who were able to go home temporarily or who were discharged with PCA increased from 37% to 55% before and after the questionnaire survey, respectively.

Among the 52 patients who implemented PCA, 21 patients experienced trouble with the PCA device. Specifically, 17 patients developed infusion site reactions (erythema, swelling, induration, bleeding, and extravasation). In all these patients, the infusion needle was withdrawn and replaced to another site. In addition, 2 patients received topical medications for the treatment of skin lesions (ulcer and induration). In 5 patients, the catheter was removed intentionally by the patient or the infusion tube was damaged accidentally. There were 2 cases of malfunction of the PCA device, 2 cases of device readjustment by an accidental alarm call during use, and 1 case of error in loading drug syringe.

## 2. The questionnaire survey to healthcare professions about PCA

Data were available from 140 healthcare professionals and the overall response rate to the questionnaire was 81%. Specifically, 10 out of 28 physicians responded (36%), 96 out of 104 nurses responded (92%), and 8 out of 8 pharmacists responded (100%). There were 1 or 2 respondents who gave no response to some questions. They were removed from the total numbers of respondents for the corresponding questions.

Respondents' professional careers ranged from 1 to 4

**Table 2** Comparisons of clinical characteristics between patients who were capable of managing rescue doses by themselves and those who were not

	Person who triggered rescue doses of PCA		
	Nurse	Self	<i>p</i>
Number ( <i>n</i> )	17	30	
Age (mean $\pm$ <i>SD</i> , years)	65.2 $\pm$ 14.0	51.6 $\pm$ 11.5	<0.01 <sup>a)</sup>
Gender (male/female)	7/10	8/22	<i>NS</i> <sup>c)</sup>
Clinical indication of PCA ( <i>n</i> )			
Cancer pain	14	28	<i>NS</i> <sup>c)</sup>
Difficulty in breathing	3	2	
Purpose of PCA ( <i>n</i> )			
Symptomatic relief	9	14	<i>NS</i> <sup>c)</sup>
Discharge or temporary return home	2	11	<i>NS</i> <sup>c)</sup>
Difficulty with taking oral medication	4	3	<i>NS</i> <sup>c)</sup>
Request of PCA by patient	1	2	<i>NS</i> <sup>c)</sup>
Others	1	0	<i>NS</i> <sup>c)</sup>
Clinical characteristics before initiating PCA ( <i>n</i> )			
Performance status (1/2/3/4)	0/0/8/9	6/9/14/1	<0.01 <sup>b)</sup>
Opioid doses (equivalent to mg of intravenous morphine hydrochloride)	61.1 [2.4–219.0] <sup>d)</sup>	82.5 [0.0–588.3] <sup>d)</sup>	<i>NS</i> <sup>b)</sup>
Frequency of rescue doses per day	2.0 [0.0–8.0] <sup>d)</sup>	3.0 [0.0–11.3] <sup>d)</sup>	<i>NS</i> <sup>b)</sup>
Symptom observed before PCA ( <i>n</i> )			
Delirium	9	1	<0.01 <sup>c)</sup>
Restlessness	5	0	<0.01 <sup>c)</sup>
Somnolence	7	9	<i>NS</i> <sup>c)</sup>
Discharge or return home temporarily	3	16	<0.05 <sup>c)</sup>

*NS*: not significant. <sup>a)</sup> Student's *t* test, <sup>b)</sup> Mann-Whitney *U* test, <sup>c)</sup> Fisher's exact test, <sup>d)</sup> Median [minimum-maximum]. No information was available from 5 patients, regarding who managed rescue doses. Two of them were discharged or allowed to return home temporarily with a PCA device.

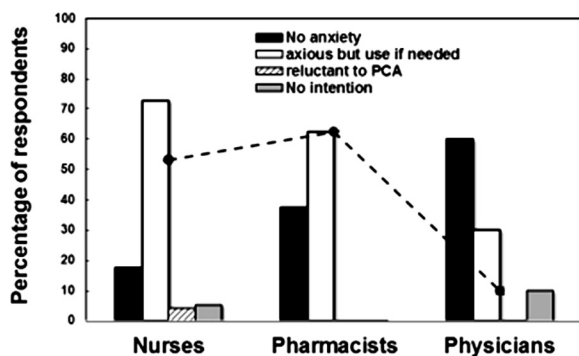
years ( $n = 20$ ), from 5 to 10 years ( $n = 18$ ), longer than 10 years ( $n = 75$ ), and unknown ( $n = 1$ ). The majority (71%) of respondents (70%, 73%, and 50% of physicians, nurses, and pharmacists, respectively) were aware that PCA was available for cancer analgesia. In addition, 70% of the medical staff who had experience with PCA gave high scores to PCA. While physicians and pharmacists expressed full satisfaction with PCA, only 66% of nurses did so. Only 29% of physicians and 25% of pharmacists who were involved in PCA reported troubles with PCA, whereas 43% of nurses involved in PCA reported some troubles. The discrepancy in the frequency of troubles encountered between nurses and the other two professionals implied that most of the troubleshooting was handled by nurses, and the troubles were not reported to physicians or pharmacists.

While 60% of the physicians were willing to implement PCA, 73% of nurses and 63% of pharmacists expressed some reservations although they understood patients' needs for PCA. They expressed a feeling of unease due to lack of experience. Only 10% of physicians compared with 53% of nurses and 63% of pharmacists were not confident about troubleshooting for the PCA device (Fig. 1). Further analysis of the data revealed that nurses with a career of 1 to 4 years experienced PCA less frequently than those with a career longer than 10 years (38% vs. 84%). None (0%) of the former group were confident about using PCA as compared the latter were (24%) (Fig. 2). Respondents to the questionnaire gave many comments and/or requests to the palliative care team. They requested the establishment of a trouble support system (68%), provision of educational sessions

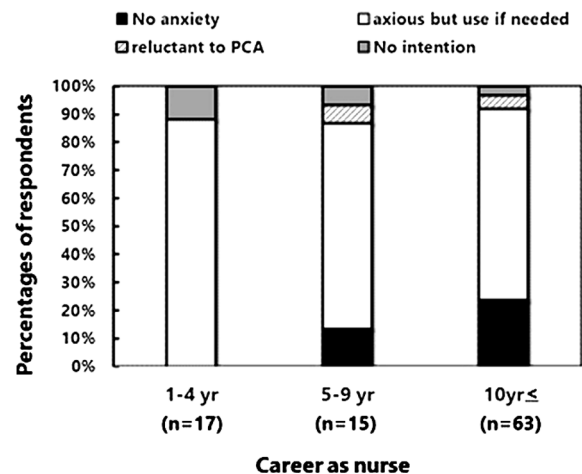
of the PCA device for healthcare staff (67%), organization of an inter-professional consensus building meeting for PCA (62%), preparation of a decision-making manual for initiating PCA (49%), and development of institutional policy for implementing PCA in cancer patients (47%) (Fig. 3).

## DISCUSSION

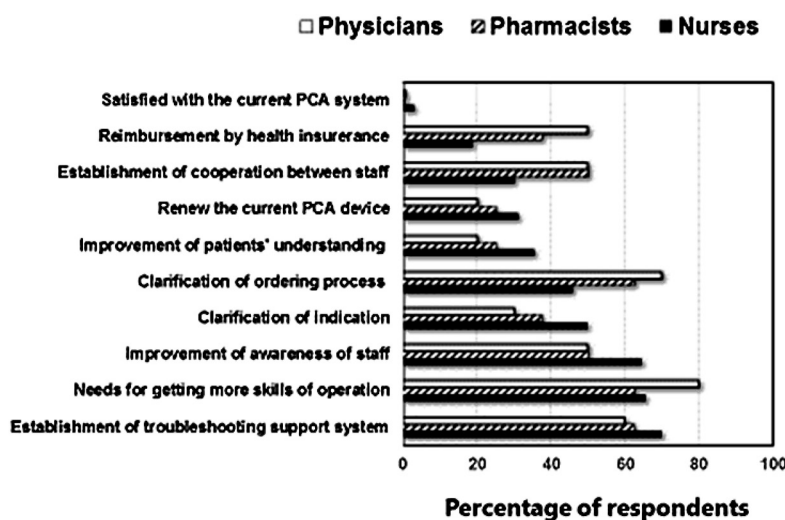
The present study confirmed the usefulness of PCA in a middle-size (250-beds), regional hospital in Japan. As high as 73% of patients with advanced cancer who used PCA achieved satisfactory analgesia. Regarding the efficacy of PCA, our findings are largely compatible with previous reports performed in the USA, EU, and Japan.<sup>5, 9-11</sup> The present study also revealed that 53% of cancer patients using PCA who managed to deliver rescue doses by themselves were discharged or allowed to go home at least temporarily with a portable PCA device. PCA may have an advantage over the traditional parenteral opioid therapy. A previous study reported that only 46% of cancer patients receiving medical care at home were able to receive subcutaneous injections of opioids due mainly to unavailability of medical care providers.<sup>12</sup> In contrast, by using PCA, patients may be able to obtain sufficient analgesia by themselves. Although 75% of deaths occur in hospitals in Japan,<sup>13</sup> the majority of patients prefer to die at home.<sup>14</sup> A previous study demonstrated that patients with advanced cancer were able to obtain analgesia safely with PCA until 1 week before death.<sup>15</sup> Another study demonstrated that a continuous infusion of opioids allowed patients to go



**Fig. 1** Healthcare professionals' attitude toward the implementation of the programmable electronic PCA device for cancer analgesia. Black, white, shaded, and gray bars represent the percentage of respondents with no anxiety, those who felt anxious but would use it if needed, those reluctant to use PCA, and those with no intention to use PCA, respectively. The percentages of the respective professionals who felt anxious about troubleshooting for the PCA device are shown by closed circles and connected with a broken line. While all physicians considered that PCA is beneficial to patients, only 66% of nurses did so. The majority of nurses and pharmacists (53% and 63%, respectively) were not confident about troubleshooting for the PCA device.



**Fig. 2** Different attitude of nurses toward the clinical service associated with PCA according to the length of career. The number of nurses who were anxious about the PCA service decreased as their professional career advanced: while none of those with a career of 1 to 4 years were confident about the PCA service, 24% of those with a career of 10 years or longer were confident about the service. These data indicate that the on-the-job-training of PCA service and device for younger nurses may facilitate acquiring skills and knowledge of PCA for accomplishing the PCA service with confidence.



**Fig. 3** Comments, concerns, and requests obtained in the questionnaire survey from different healthcare professionals (physicians, nurses, and pharmacists) about the implementation of the programmable electronic PCA for cancer patients. Respondents to the questionnaire gave many comments and/or requests to the palliative care team. Among those, major requests were those for the establishment of a trouble support system (68%), provision of educational sessions of the PCA device for healthcare staff (67%), organization of inter-professional consensus building meeting for PCA (62%), preparation of a decision-making manual for initiating PCA (49%), and development of institutional policy for implementing PCA in cancer patients (47%).

home until 15 days before the end of life.<sup>16)</sup> The present study revealed that PCA was utilized in only 13% of patients with advanced cancer who could have benefited from this method. We also revealed that only 64% of the PCA users (30 of 47 patients) were able to manage rescue doses by themselves, indicating that the advantage of PCA over traditional oral or parenteral analgesic pharmacotherapy was not fully utilized (Table 2). Collectively, we consider that promulgation of PCA in palliative care for cancer patients would meet patients' needs in Japan.

In the present study, we aimed to clarify the reasons why the dissemination of PCA for cancer patients has been slow in Japan. The questionnaire revealed that the majority (71%) of healthcare professionals were aware of the availability of PCA in the hospital. Nevertheless, only 60% of the physicians were in favor of implementing PCA, and 73% of nurses and 63% of pharmacists expressed some reservations in using PCA (Fig. 1). While all physicians considered that PCA is beneficial to patients, only 66% of nurses did so. In particular, nurses and pharmacists expressed a feeling of unease due to a lack of experience. The majority of nurses and pharmacists (53% and 63%, respectively) were not confident about troubleshooting for the PCA device. They requested the hospital palliative care team to establish a trouble support system (68%) for PCA, provide competency training on the PCA device (67%), organize inter-professional consensus building meetings of PCA (62%), clarify the decision-making processes of PCA implementation (49%), and establish an institutional economic policy about PCA (47%). This feedback indicates that a systematic and comprehensive approach involving different healthcare professionals would be required for

promulgating PCA in the hospital. Previous studies reported that pharmacists may play an important role in building an inter-professional palliative care team in hospitals.<sup>11,17)</sup> In order to remove or alleviate the obstacles for the introduction of PCA that were revealed by the questionnaire survey, the pharmacists in the palliative care team (A.S. and others) made the following efforts: they provided lectures on palliative care and PCA for ward nurses and other pharmacists, made a user manual of PCA, and provided on-the-job-training for less experienced, young nurses about the loading and disposal of drug solution cassettes to the PCA device. They also gave advice to physicians for utilizing PCA in eligible patients, undertook an opioid-round for all patients receiving opioids for cancer analgesia once a week, and gave advice for introducing PCA for eligible patients. While these efforts did not increase the numbers of patients utilizing PCA before and after the questionnaire survey (5.9 versus 3.7 patients/year, respectively), the percentages of patients who were able to go home temporarily or discharged with PCA increased to 55% after the questionnaire survey as compared to 37% before the survey.

An economic issue exists for implementing PCA in patients with advanced cancer. At present, two types of PCA device are available. One is a programmable electronic PCA pump and the other is an elastomeric (pneumatically driven) disposable PCA pump. At present, the disposable type is more frequently utilized than the programmable type due mainly to economic reason. For postoperative patients who need fixed infusion rates of analgesic drugs, the disposable PCA pump may have an advantage. In addition, the disposable PCA device is reimbursable under the current universal healthcare

system. In contrast, the programmable electronic PCA pump may be preferred for cancer analgesia, because the infusion rate can be varied according to the severity of pain in individual patients. In addition, the electrical PCA pump allows setting of individualized rescue doses for breakthrough pain. However, the programmable PCA pump is more expensive than the disposable PCA pump, and the consumables are not reimbursable by the universal health insurance coverage. This would be one of the reasons why the electronic PCA device has not been promulgated in Japan. At present, the PCA device has been used routinely for cancer analgesia in only 63% of the regional hub cancer centers designated by the Ministry of Health, Welfare and Labour.<sup>18)</sup> Since the reimbursement to medical providers by the government is based on a fixed per *diem* payment for each item of service according to the diagnosis procedure combination (DPC), routine use of the programmable electronic PCA for cancer patients may adversely affect the revenue of hospitals. Nevertheless, a previous study conducted in the USA suggested that longer use of PCA tended ( $p = 0.054$ ) to decrease the readmission rates within 30 days after discharge.<sup>19)</sup>

Considering the costs for PCA, it would be important to implement PCA only in patients who will benefit from the unique advantage of PCA. The present study revealed significant differences in clinical characteristics between patients who were able to manage rescue doses by themselves and those who were not; the former exhibited significantly better PS and less frequent delirium before initiation of PCA than the latter. These data suggest that prudent clinical evaluation is important for making the decision of adopting PCA for a patient. Our data may also provide useful information for establishing institutional criteria for the indication of PCA in the future. In addition, our study revealed that 54% of cancer patients used the PCA device until death. When patients approach the terminal phase, they often become unconscious and no longer require analgesia. In this context, there is a concern that reappraisal of the indication of PCA may have been inadequate. In order to contain medical costs, the clinical indication of PCA for advanced cancer patients should be reappraised regularly. When the clinical conditions of a patient exclude the indication of PCA, it should be withdrawn promptly to avoid unnecessary costs during admission.

Previous studies<sup>6, 10)</sup> reported that use of a PCA device after discharge or during a short stay at home required extra human resources for troubleshooting. A previous nationwide questionnaire survey revealed that a shortage of human resources was one of the reasons (47%) that hampered the introduction of PCA into clinical practice.<sup>20)</sup> In real-world practice, operation of the PCA pump often poses different types of troubles. In the present study, we revealed that approximately 40% (21 of 52) of patients who used PCA experienced some trouble associated with PCA. The questionnaire revealed that 29%, 25%, and 43% of physicians, pharmacists, and

nurses, respectively, were involved in some types of trouble during the operation of PCA. These data indicate that nurses were mainly responsible for PCA-associated troubleshooting. These data indicate the needs of a competency training program for nurses with a short career (1–4 years) and a comprehensive instruction manual of the device. In this context, Yoshioka et al.<sup>21)</sup> reported that a pharmacist-led PCA dosing service for patients was effective in their institution. A previous study conducted in the US also showed that pharmacist-led PCA dosing service was effective in reducing adverse effects and improving QOL of patients.<sup>17)</sup>

In conclusion, PCA should be further promulgated in cancer in-patients to improve their QOL. The palliative care team may have a pivotal role in the comprehensive and systematic approach of implementing PCA in the hospital. Pharmacists are expected to play an important role in the palliative care team.

**Conflict of Interest:** The authors declare that they have no competing interests regarding the present article.

## ACKNOWLEDGEMENTS

Authors appreciate the cooperation of healthcare staff for conducting the present study.

## REFERENCES

- 1) Greco MT, Roberto A, Corli O, et al. Quality of cancer pain management: An update of a systematic review of under-treatment of patients with cancer. *J. Clin. Oncol.* 2014; 32: 4149–4154.
- 2) Japanese Society for Palliative Medicine. Clinical guideline for cancer pain management. 2nd ed. 2014. Kanehara & Co., Ltd., Tokyo, Japan, pp. 42–50.
- 3) Citron ML, Kalra JM, Seltzer VL, et al. Patient-controlled analgesia for cancer pain: A long-term study of inpatient and outpatient use. *Cancer Invest.* 1992; 10: 335–341.
- 4) Swanson G, Smith J, Bulich R, et al. Patient-controlled analgesia for chronic cancer pain in the ambulatory setting: A report of 117 patients. *J. Clin. Oncol.* 1989; 7: 1903–1908.
- 5) Meuret G and Jocham H. Patient-controlled analgesia (PCA) in the domiciliary care of tumour patients. *Cancer Treat. Rev.* 1996; 22: 137–140.
- 6) Lux EA and Heine J. Home care treatment of cancer pain patients with patient-controlled analgesia (PCA). *Schmerz.* 2011; 25: 663–667.
- 7) Otomo S, Sasakawa T, and Kunisawa T. Benefits of CADD Legacy<sup>®</sup> (Smith Medical). *J. Jpn. Soc. Clin. Anesth.* 2010; 30: 842–848.
- 8) Ministry of Health, Labour and Welfare, Japan. Guideline for appropriate handling of personal information for medical and healthcare professionals. (in Japanese) <http://www.mhlw.go.jp/topics/bukyoku/seisaku/kojin/dl/170805-11a.pdf> (accessed on 7 April 2018).
- 9) Ferrell BR, Nash CC, and Warfield C. The role of patient-controlled analgesia in the management of cancer pain. *J. Pain Symptom. Manage.* 1992; 7: 149–154.
- 10) Schiessl C, Bidmon J, Sittl R, et al. Patient-controlled analgesia (PCA) in outpatients with cancer pain. Analysis of 1,692 treatment days. *Schmerz.* 2007; 21: 35–38, 40–42.
- 11) Shibata K, Uragami Y, Kawakami N, et al. Establishment of regional alliance for implementing a continuous infusion

- of opioids with PCA pump at home. *Palliat. Care Res.* 2015; 10: 901-905.
- 12) Yamagishi A, Morita T, Miyashita M, et al. Providing palliative care for cancer patients: The views and exposure of community general practitioners and district nurses in Japan. *J. Pain Symptom. Manage.* 2012; 43: 59-67.
- 13) Brief summary of the Japanese vital statistics in 2016, <http://www.mhlw.go.jp/toukei/saikin/hw/jinkou/kakutei16/index.html> [in Japanese], accessed on March 29, 2018.
- 14) The report of consciousness survey on the health of elderly in 2012, Japan, <http://www8.cao.go.jp/kourei/ishiki/h24/sougou/gaiyo/index.html> [in Japanese], accessed on March 28, 2018.
- 15) Schiessl C, Sittl R, and Griessinger N. Intravenous morphine consumption in outpatients with cancer during their last week of life—An analysis based on patient-controlled analgesia data. *Support. Care Cancer* 2008; 16: 917-923.
- 16) Kobayashi T, Murakami M, Yamamoto N, et al. Support for leaving the palliative care unit temporarily in end-stage terminally ill cancer patients. *Palliat. Care Res.* 2014; 9: 301-307.
- 17) Dezia AL, Baccus TD, Natavio AM, et al. Implementation of a pharmacist-led patient-controlled analgesia dosing service. *Pain Practice* 2017; 17: 990-998.
- 18) Sugiura M, Miyashita M, Sato K, et al. A national wide survey of the palliative care provided by pharmacists in designated regional cancer centers in Japan. *Jpn. J. Pharm. Palliat. Care Sci.* 2011; 4: 23-30.
- 19) Martin EJ, Roeland EJ, Sharp MB, et al. Patient-controlled analgesia for cancer-related pain: Clinical predictors of patient outcomes. *JNCCN* 2017; 15: 595-600.
- 20) Namiki Y and Omote K. *Patient-controlled anesthesia.* 2004. Kokuseido Publishing Co., Tokyo, pp.119-127.
- 21) Yoshioka H, Kajita E, Ikari H, et al. The role of pharmacists in cancer pain management using a patient controlled analgesia (PCA) pump. *J. Jpn. Soc. Hosp. Pharm.* 2006; 42: 1471-1475.