

# Prospective cohort study on the incidence and risk factors of emergency home visits among Japanese home care patients

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## Abstract

**Background:** Population aging requires more physician home visits, and various measures need to be taken to reduce the burden on visiting physicians. However, the incidence and associated factors of burdensome emergency home visits remain unclear. We aimed to reveal the incidences of emergency home visits among cancer and non-cancer patients and examine how visiting nurses affect those.

**Methods:** We performed a prospective cohort study across three clinics in Japan and enrolled the patients receiving home visits within a 3-month study period. We calculated the incidence rates using person-time at risk and conducted a Cox regression in the analysis of risks for emergency home visits.

**Results:** A total of 278 patients were analyzed. The incidences of emergency home visits among the overall, the cancer, and the noncancer home care patients were 1.61, 7.23, and 1.37 per 10 person-months, respectively. The adjusted hazard ratios of a cancer-bearing state and visiting nurse service use were 4.71 (95% confidence interval [CI], 2.60–8.52) and 1.85 (95% CI, 1.77–1.94), respectively.

**Conclusions:** The incidence of emergency home visits among cancer patients was around five times greater than noncancer patients. Our study did not demonstrate that visiting nurses prevent emergency home visits. Further studies are needed to clarify how visiting nurses reduce physicians' burden.

## KEYWORDS

family medicine, geriatrics, health policy, home medical care, research

## 1 | INTRODUCTION

Patient-centered care has been gaining greater attention in the discussion of quality.<sup>1</sup> As for patient-centered care for cancer patients, a population-based survey conducted in European countries revealed that home care is a valuable way to achieve it, especially in terminal stages.<sup>2</sup> As Tralongo et al. argued, the

cancer patient-centered home care framework aims at several targets: enhanced patient–physician relationship; coordinated, comprehensive, and accessible care; and assured quality and safety.<sup>3</sup> In line with this international trend, Japan's Ministry of Health, Labour and Welfare has promoted physician home visits to provide better patient-centered care and end-of-life care in their familiar place to live.<sup>4</sup>

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On the other hand, 75% of primary care physicians providing home visits feel 24-hour on-call system as a heavy burden.<sup>5</sup> Policymakers need to consider appropriate measures to reduce the physical and psychological burdens of primary care physicians providing home visits. To reveal the level of the burden, we first need to accumulate the findings on emergency home visits in Japan.

Although there is Japanese evidence that home visits for cancer patients are cost-saving<sup>6</sup> and can achieve good death<sup>7</sup> than hospital care, there is scarce research on the frequency of emergency home visits. Kaneko et al.<sup>8</sup> and Kuroda et al.<sup>9</sup> investigated the reason for and the factor of emergency home visits for cancer patients, respectively, but the incidence has not yet been investigated. Furthermore, the results that a cancer-bearing state was not associated with the frequency of emergency home visits should be reexamined. Because the analyses did not consider cancer patients' shorter survival time, they could have underestimated the association. The incidence of emergency home visits, especially among cancer patients, is vital information when primary care physicians who have never offered home visits determine whether they newly provide home visits or not. The information is also essential for policymakers to consider appropriate measures to reduce the burden.

The association between the use of visiting nurse services and emergency home visits also remains unclear. The services are expected to reduce primary care physicians' burden as a part of their nurse works.<sup>5</sup> However, the evidence on the relationship between the use of visiting nurse services and emergency department use, as an alternative to emergency home visit use, is mixed.<sup>10-12</sup> Although Reckrey et al.<sup>13</sup> argued that a team-based home care model including nurses increased physician panel size and physician satisfaction, whether such a model reduces the frequency of emergency home visits remains unknown. The information about the association would help policymakers design an appropriate home care model in Japan.

Considering the above, we aimed to reveal the incidences of emergency home visits among cancer and noncancer patients and evaluate how visiting nurses affect those.

## 2 | METHODS

### 2.1 | Study design and participants

We performed a prospective cohort study across three clinics providing home visits in Japan. Those were located in Sapporo City in Hokkaido, Muroran City in Hokkaido, and Ogori City in Fukuoka. Each clinic was an enhanced home medical care support clinic in suburban areas with equal or more than three physicians and had around 150 home care patients. We defined home visits as regular consultations at home for patients with chronic care conditions and emergency home visits as unplanned consultations at home for patients with acute care conditions at the request of themselves or their caregivers. Most of the patients received regular home visits every 2 weeks.

We enrolled the patients receiving home visits within the 3-month study period between September 1, 2019, and November 31, 2019. Exclusion criteria were as follows: (i) dementia living alone or living in communal daily long-term care facilities (group homes) and (ii) highly severe conditions with an estimated prognosis of fewer than 2 weeks.

### 2.2 | Outcome and exposure measurements

We measured the time to the first emergency home visit of each patient using medical records. Person-time at risk was calculated from the day of informed consent obtained. Emergency home visits were categorized according to whether they occurred on holidays or at defined times during the weekdays: working hours, night, or middle of the night. Because emergency home visits during out of working hours can be highly exhausting, the information would be essential when considering policies to support home care physicians. Observations of participants were censored: (i) when they died at home or (ii) at the end of the study period. The measurements were interrupted when participants were admitted to hospitals and were resumed when they returned under home care.

We also recorded the following characteristics at the time of participants' entry: cancer status, visiting nurse use, age, gender, parenteral nutrition use, central venous port use, mechanical ventilation use, and home oxygen use. We found that our cohort had no central venous port users during the study period, although we usually provide home visits to those patients. Kuroda et al.<sup>9</sup> reported that the level of care needed and urinary catheter use affected the emergency home visits for mainly fever management, yet we did not measure those factors. According to our clinical experience, fever is not a significant reason for emergency home visits among cancer patients. Thus, we did not assume that those factors affect emergency home visits among cancer patients.

### 2.3 | Statistical analysis

We could not find appropriate literature regarding the frequency of emergency home visits among cancer patients, and we discussed the extent to which differences should be detected. We hypothesized the following conditions: hazard ratio among cancer patients, 3.0; power, 0.8; event probability, 0.3; and the squared coefficient of multiple correlations with covariates, 0.1. Then, the required sample numbers and events were estimated as 268 and 81, respectively.

The characteristics of patients and emergency home visits by cancer status were compared using Mann-Whitney U-tests for continuous variables and Fisher's exact tests or Pearson's  $\chi^2$  tests for categorical variables. We planned to conduct a time-to-event analysis with the event defined as the first emergency home visit. We evaluated the proportional hazards assumption in the analysis using the complementary log-log plot, and the assumption was not violated. Therefore, we conducted a Cox regression using cluster-robust standard errors to consider that data were collected from three clinics.

We implemented only a cancer-bearing state among various disease states into the multivariate analysis because we assumed that those states were almost equally distributed among cancer and noncancer patients. Then, we added the other independent variables that can affect the risk of emergency home visits among cancer patients as confounders, including visiting nurse use. Finally, the independent variables included cancer status, visiting nurse use, age, gender, parenteral nutrition use, mechanical ventilation use, and home oxygen use. To facilitate the hazard ratio interpretation in the multivariate analysis, the age variable, which was a continuous variable, was transformed into a categorical variable using the median. We used a complete case analysis approach regarding missing baseline data, but there were no missing data. We had no loss to follow-up cases.

*P*-values less than 0.05 were considered statistically significant. All statistical analyses were carried out using Stata v15.1 (StataCorp, College Station, TX, USA).

## 2.4 | Ethical considerations

This study was conducted in accordance with “Ethical Guidelines for Medical and Health Research Involving Human Subjects” by the Ministry of Health, Labour and Welfare and was approved by the Japan Primary Care Association Research Ethics Committee (approval number: R1-4). We obtained written informed consent from each patient or patient's family member regarding capacity to provide consent and surrogate consent.

## 3 | RESULTS

### 3.1 | Patient characteristics

Of 475 potential participants, 180 were found to be ineligible. Of the remaining 295 participants, 278 (94.2%) were recruited. Because there were no incomplete data or loss to follow-up cases,

278 participants were finally included in the analyses (Figure 1). Table 1 outlines patient characteristics. The mean age of the cohort was 81.1 years, and the distribution was skewed left. The median age of the cancer patients was 85 years, and that of the noncancer patients was 86 years. The cancer patients were composed of more male, while the noncancer patients consisted of more female. The percentage of the home oxygen users was higher among the cancer group than the noncancer group. There was no statistically significant difference between the cancer group and the noncancer group regarding the percentage of the users of visiting nurse service, parenteral nutrition, and mechanical ventilation.

### 3.2 | Characteristics of emergency home visits

Table 1 shows the characteristics of emergency home visits. The percentage of the cases receiving emergency home visits was significantly higher among the cancer patients than the noncancer patients (78.3% vs 29.4%). There was no statistically significant difference between the cancer and the noncancer patients in terms of the time of day in which emergency home visits occurred. The percentage of the cases receiving emergency home visits on holiday was 5.6% among the cancer patients and 6.7% among the noncancer patients, and the difference was not statistically significant. The median day to the first emergency home visit was 26 among the cancer patients and 79 among the noncancer patients, which was significantly shorter among the cancer patients.

### 3.3 | Incidence rate of emergency home visits

Table 2 indicates the incidence table for emergency home visits. The incidences of emergency home visits among the overall, the cancer, and the noncancer patients were 1.61, 7.23, and 1.37 per 10 person-months, respectively. The incidence rate ratio among the

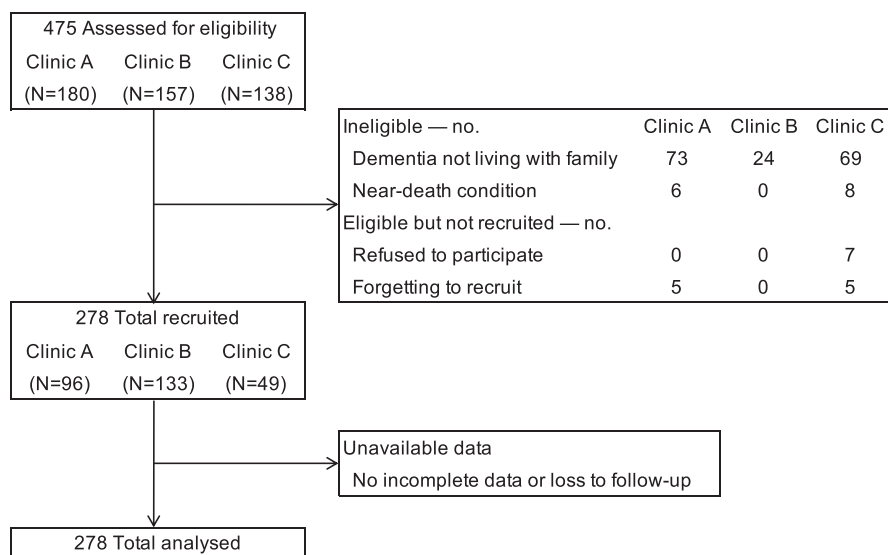


FIGURE 1 Participant flow diagram

**TABLE 1** Patient and emergency home visit characteristics

	Total (N = 278)	Cancer (N = 23)	Noncancer (N = 255)	p-value
Patients, no. (%)				
Clinic A	96 (34.5)	4 (17.4)	92 (36.1)	0.149 <sup>a</sup>
Clinic B	133 (47.8)	15 (65.2)	118 (46.3)	
Clinic C	49 (17.6)	4 (17.4)	45 (17.6)	
Age, median (IQR), years old	85 (75-92)	85 (71-91)	86 (76-92)	0.799 <sup>b</sup>
Sex, no. (%)				
Female	165 (59.3)	8 (34.8)	157 (61.6)	0.012 <sup>c</sup>
Male	113 (40.7)	15 (65.2)	98 (38.4)	
Visiting nurse use, no. (%)	203 (73.0)	18 (78.3)	185 (72.6)	0.633 <sup>a</sup>
Parenteral nutrition use, no. (%)	36 (13.0)	1 (4.4)	35 (13.7)	0.33 <sup>a</sup>
Central venous port use, no. (%)	0 (0)	0 (0)	0 (0)	
Mechanical ventilation use, no. (%)	11 (4.0)	0 (0)	11 (4.3)	0.608 <sup>a</sup>
Home oxygen use, no. (%)	20 (7.2)	5 (21.7)	15 (5.9)	0.017 <sup>a</sup>
Period under home care, median (IQR), days	81 (73-86)	42 (11-79)	82 (78-86)	<0.001 <sup>b</sup>
Cases receiving the 1st EHV, no. (%)	93 (33.5)	18 (78.3)	75 (29.4)	<0.001 <sup>c</sup>
Cases receiving the 1st EHV in the defined time periods, no. (%)				
8:00–18:00	76 (27.3)	13 (72.2)	63 (84.0)	0.345 <sup>a</sup>
18:00–22:00/6:00–8:00	14 (5.0)	4 (22.2)	10 (13.3)	
22:00–6:00	3 (1.1)	1 (5.6)	2 (2.7)	
Cases receiving the 1st EHV on holiday, no. (%)	6 (5.6)	1 (5.6)	5 (6.7)	1 <sup>a</sup>
Time to the 1st EHV, median (IQR), days	78 (38-85)	26 (7-42)	79 (45-85)	<0.001 <sup>b</sup>

Abbreviations: IQR, interquartile range; EHV, emergency home visit

<sup>a</sup>Fisher's exact test.

<sup>b</sup>Mann-Whitney *U*-tests.

<sup>c</sup>Pearson's  $\chi^2$  tests

**TABLE 2** Incidence table for emergency home visits

Incidence rate, per 10 person-months	
Overall	1.61
Cancer	7.23
Noncancer	1.37
Incidence rate ratio in cancer to noncancer patients (95% CI)	5.30 (2.93–9.07)

Abbreviation: CI, confidence interval.

cancer patients to the noncancer patients was 5.30 (95% confidence interval [CI], 2.93–9.07).

### 3.4 | Risk factors for emergency home visits

Figure 2 shows the Cox adjusted time-to-event curves for the cancer and the noncancer patients. The curves were adjusted for visiting

nurse use, age, gender, parenteral nutrition use, mechanical ventilation use, and home oxygen use. The curves represent emergency-home-visit-free probability among the cancer and the noncancer patients. Table 3 shows the results of Cox regression of time until the first emergency home visits. The hazard ratios of a cancer-bearing state and visiting nurse service use were 4.71 (95% CI, 2.60–8.52) and 1.85 (95% CI, 1.77–1.94), respectively, and both were statistically significant. The hazard ratios of the other variables, including

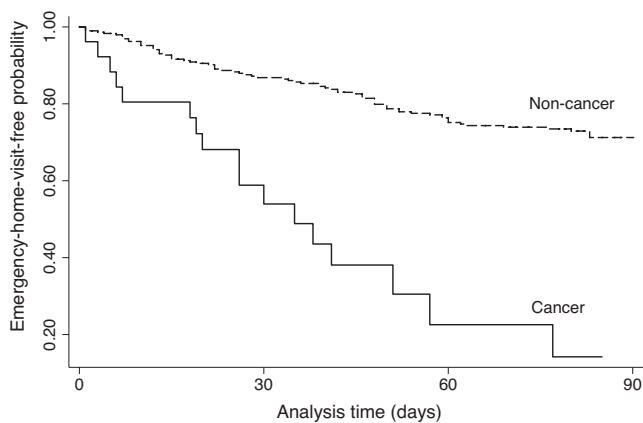
age over 85, female, parenteral nutrition use, mechanical ventilation use, and home oxygen use, were not statistically significant.

## 4 | DISCUSSION

This study investigated the incidence of emergency home visits among Japanese home care patients. The incidences of emergency home visits among the overall, the cancer, and the noncancer home care patients were 1.61, 7.23, and 1.37 per 10 person-months, respectively. The adjusted hazard ratios of a cancer-bearing state and visiting nurse service use were 4.71 (95% CI, 2.60–8.52) and 1.85 (95% CI, 1.77–1.94), respectively.

### 4.1 | Patient characteristics

The age distribution and proportion of the cancer patients in the cohort were almost consistent with a national survey on home care patients by the Ministry of Health, Labour and Welfare.<sup>14</sup> The mean age of the patients receiving home visits was 81.1 years. It



**FIGURE 2** Cox adjusted time-to-event curves for the cancer and the noncancer patients. The curves were adjusted for age, gender, use of visiting nurse, parenteral nutrition, mechanical ventilation, and home oxygen

was similar to the mean age of 82.2 and 82.8 years in recent studies conducted in Japan.<sup>8,9</sup> Kaneko et al.<sup>8</sup> reported that the mean age of the patients receiving home visits in Japan was higher than that in the UK<sup>15</sup> and Australia.<sup>16</sup> The difference may be caused by Japan's policy promoting home care for older adults<sup>4</sup> and, as Ishida et al.<sup>17</sup> suggested, inequitable access to appropriate healthcare resources among the pediatric population.

### 4.2 | Characteristics of emergency home visits

Most emergency home visits to the cancer and the noncancer patients occurred during office hours (72.2% and 84.0%, respectively), and emergency home visits in the middle of the night (22:00–6:00) or on holiday were around 5% each. In a study investigating characteristics of app-based physician house calls in the United States, the percentage of house calls on Sunday was 17.0% among pediatric users and 12.5% among adults.<sup>18</sup> As Ishii et al.<sup>19</sup> argued, patients receiving home visits and their families may be reluctant to ask doctors to make emergency home visits on Sunday. We need to be careful to compare our results to findings from the study conducted in the United States<sup>18</sup> because there would be a cultural difference in the patient–physician relationship. Furthermore, the app-based system could lower the psychological hurdle to request emergency home visits. Further studies are needed to clarify why there are fewer emergency home visits on Sunday compared to weekdays among Japanese home care patients.

### 4.3 | The incidence of emergency home visits

To the best of our knowledge, this is the first report of the incidence of emergency home visits. This information is vital for primary care physicians who are considering starting home visits because the information enables them to estimate how many emergency home visits they need to offer. This study demonstrated that the incidence of emergency home visits among cancer patients was around five times greater than that among noncancer patients. It means that home care for cancer patients demands enormous resources.

Variables	Hazard ratio	Cluster-robust standard error	95% CI	P-value
Cancer	4.71	1.43	2.60–8.52	<0.001
Visiting nurse use	1.85	0.05	1.77–1.94	<0.001
Age >85	1.16	0.39	0.60–2.22	0.663
Female	0.75	0.17	0.48–1.19	0.220
Parenteral nutrition use	1.40	0.34	0.86–2.27	0.173
Mechanical ventilation use	1.47	1.33	0.25–8.69	0.671
Home oxygen use	0.87	0.08	0.72–1.06	0.721

**TABLE 3** Results of Cox regression of time to emergency home visits

Abbreviation: CI, confidence interval.

The percentage of the cancer patients who received more than one emergency home visit during the 3-month study period was 78.3%. In studies conducted in Saudi Arabia<sup>20</sup> and Taiwan,<sup>21</sup> 77% and 81.5% of terminal cancer patients had at least one emergency department visit during the 3-month and one-year study period, respectively. Those percentages are similar to that of patients receiving emergency home visits in our study. Barbera et al.<sup>22</sup> reported that many visits to emergency departments by terminal cancer patients could be avoidable, and several studies showed that increased access to home and community care could reduce unnecessary emergency department visits.<sup>23,24</sup> In light of these research findings, regular home visits to cancer patients provided by primary care physicians could prevent them from visiting emergency departments by providing alternative emergency home visits.

As for the healthcare cost of home visits to both cancer and noncancer patients, the evidence is mixed.<sup>6,25-28</sup> However, the evidence on the cost of care among cancer patients is consistent.<sup>6,25,26,29</sup> Reeve et al.<sup>29</sup> reported that the cost of care among cancer patients gradually increased in the last 6 months of life, mainly because of patients' hospitalization. Kato and Fukuda<sup>6</sup> demonstrated that the cost of home-based palliative care, including those of medications, long-term care insurance services, and visiting nurse services, was substantially lower than hospital-based palliative care despite similar treatment durations of the groups. In terms of reimbursement appropriate to the level of burden, policymakers may need to revisit the proper fee for home visits to cancer patients.

#### 4.4 | The factors associated with emergency home visits

We revealed that a cancer-bearing state is a risk factor for emergency home visits through the multivariate Cox regression analysis (hazard ratio, 4.71; 95% CI, 2.60 to 8.52). The result is different from the finding of the study of Kuroda et al.<sup>9</sup> Their analyses did not include each case's follow-up period. They could have underestimated the cancer status's statistical weight because cancer patients usually have shorter survival than noncancer patients.

Visiting nurse use was also associated with an increase in the risk of emergency home visits (hazard ratio, 1.85; 95% CI, 1.77-1.94). This result is reasonable in light of the research of Jones et al.,<sup>12</sup> in which patients receiving home care were more likely to visit emergency departments on the same days when they received a nursing visit. Alternatively, it could be explained by the idea that patients with unstable conditions are likely to use visiting nurse service than patients with stable conditions, resulting in frequent emergency home visits among the service users. Visiting nurses may reduce home visit physicians' burden, but the mechanism would be explained by reducing physicians' predefined tasks or consultation time, for example. It should be examined in future studies.

#### 4.5 | Strengths and limitations of this study

This study has several strengths. First, it revealed the incidence of emergency home visits among Japanese home care patients. Second, it re-evaluated the significance of a cancer-bearing state as a risk factor of emergency home visits. Finally, it did not show that visiting nurse services prevent emergency home visits. Those results may be useful for policymakers to consider appropriate supports for home visit physicians.

This study has several limitations. First, our results could lack the representativity of institutions providing home care in Japan because we recruited only three clinics. Although patient characteristics were similar to those in studies of Japanese home care patients,<sup>8,9</sup> physician and family characteristics could affect emergency home visits. Second, the participants of this study did not include patients living in nursing homes due to severe dementia because we were unable to obtain informed consent from those patients. These patients were not considered to be capable of consenting to participate in the study and did not have families nearby to obtain informed consent by proxy. The lack of enrollment of these patients could cause underestimation of the incidence of emergency home visits among noncancer patients. Lastly, unobserved confounders, such as disease severity, emergency home visit preferences, and socioeconomic status, could affect the Cox regression results, and those unadjusted confounders could make the estimates inconsistent.

### 5 | CONCLUSION

We investigated the incidence of emergency home visits among Japanese home care patients. The incidence of emergency home visits among cancer patients was around five times greater than that among noncancer patients. We also identified a cancer-bearing state and visiting nurse service use as risk factors for emergency home visits. Further studies are needed to clarify how visiting nurses reduce physicians' burden.

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#### CONFLICT OF INTEREST

The authors have stated explicitly that there are no conflicts of interest in connection with this article.

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