

Research on Home Care Nursing in Japan Using Geographic Information Systems: A Literature Review

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ABSTRACT: Given Japan's super-ageing society and its need for developing community-based integrated care system, the role of home care nursing is becoming increasingly important. A central concern in home care nursing is regional/spatial placement of home nursing stations and accessibility for patients. Analysis based on geographic information systems (GIS) may be useful in home care nursing research. We conducted a literature review of home care nursing research based on GIS in Japan. A total of 4 articles were selected following a search of medical literature databases. The first report was published in 2014. Most subjects in the identified studies were older people. Most studies were implemented at a municipal level. Key themes in the identified studies were "placement of specialists and home nursing stations" and "placement of home nursing stations and target patients." Despite the paucity of research, as all identified studies examined the community areas with an aged population, it may point to the need to consider community-based integrated care systems, including home care nursing, in Japan. More GIS-based research on home care nursing is called for.

KEYWORDS: Home care nursing, balance of supply and demand, spatial analysis, regional analysis, community medicine, GIS

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Introduction

In Japan, 26.7% of the population was aged 65 years or more in 2015, meaning that Japan has the highest rate of aged population in the world.¹ Given Japan's rapidly aging population and declining birthrate,¹ establishing a community-based integrated care system to support older people in the community is an urgent issue.^{2,3} In Japan, a community-based integrated care system is defined as a conceptual community model that provides housing as a basic function, along with various life support services to ensure the safety, security, health, and welfare of all older people.⁴ Home care nursing is a pivotal part of community-based integrated care systems to support older people in the community.^{1,3}

Home care nursing is a service in which nurses visit patients' homes to provide nursing care for illness and/or disability.¹ In total, 612 200 people/year actually received home care nursing in the Japanese 2016 fiscal year, which represented an increase of 8.2% from the previous year.⁵ In addition, there were 9525 home nursing stations that formed the basis of home care nursing services in 2016, representing an increase of 8.9% from the previous year.⁶ These increases were the largest among all at-home health, welfare, and medical services (these services are components of the community-based integrated care system),^{5,6} highlighting the increased/continued need of home care nursing in Japan.

Home care nursing is generally provided by nurses in home nursing stations.^{1,7,8} Each home nursing station is certified by the prefecture to which the station belongs, and the services provided are covered by national insurance.¹ Therefore, the

accessibility and geographical placement of home nursing stations are central concerns.^{7,8} In recent years, geographic information systems (GIS) have been used in research on medical accessibility and socio-medical resource distribution.^{9–11} GIS is a technology used to visualize data and enables analysis by spatial information for the place/region.^{12,13} In this context, herein, we aimed to review the status and content of GIS-based research on home care nursing in Japan.

Materials and Methods

We conducted a search of Ichushi-Web (a Japanese medical article database) and PubMed, up to June 2, 2018. The search of Ichushi-Web was conducted using 2 keywords: "homonkango" (a Japanese language of home care nursing) AND "chirijohoshisutemu" (geographical information systems). This search identified 4 original articles. The PubMed search was conducted with 3 keywords: "home care nursing" AND "geographical information systems" AND "Japan." This search also identified 4 original articles. There were no duplications among these 8 studies.

The abstracts of the original articles were independently screened by 2 authors of this study. These authors independently checked the research designs and methods of the identified studies.^{14–17} There was no disagreement regarding selected studies between the 2 authors. This screening process excluded 4 studies that did not directly examine home care nursing (4 studies), did not use GIS (1 study), or concerned engineering research (1 study). Finally, 4 studies were selected for inclusion in this review (Figure 1).



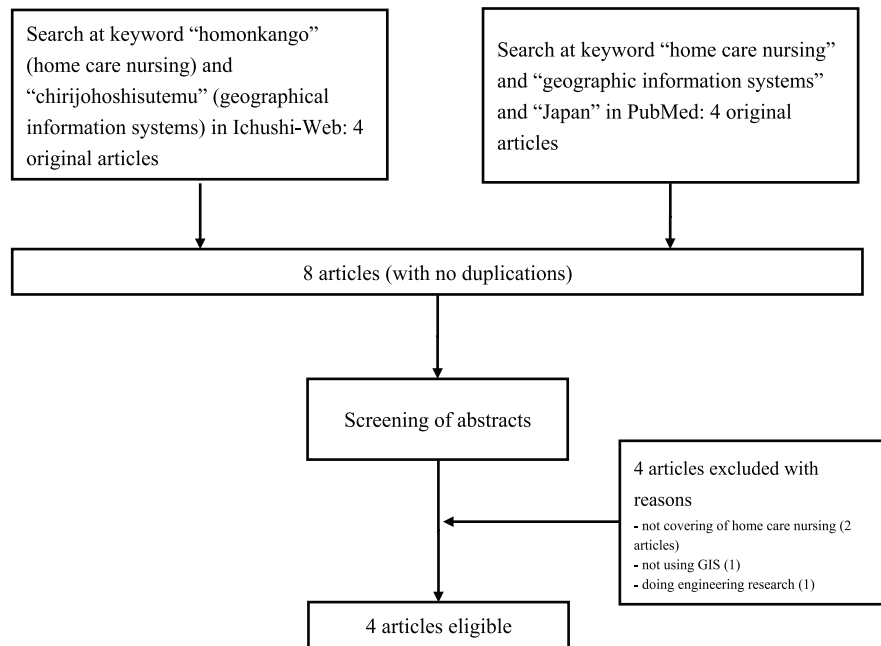


Figure 1. Flowchart of the study selection process.

We conducted an additional search of the CINAHL database using the same method. No studies were identified in that search.

Results

Characteristics of the selected studies

The 4 selected studies^{18–21} are shown in Table 1. These were studied in each prefecture in the whole of Japan (1 study¹⁸) or municipalities in the prefecture (3 studies^{19,21}). Target subjects were older people (3 studies^{18,20,21}) and patients with pressure ulcers (1 study¹⁹). The main aim of the selected studies was to examine the distribution of home care nursing using GIS. In total, 2 studies used ArcGIS software,^{19,21} 1 used MANDARA,¹⁸ and 1 used spatial information system (SIS).²⁰ The main GIS methods used were “mapping” to visualize the distribution and “buffer” to evaluate the coverage area. There were 2 types of GIS data used in the selected studies: (1) data for patients obtained based on written consent from that municipality²¹ and (2) data for home nursing stations and medical facilities obtained from public information on the homepages of municipalities and academic societies.^{18–21}

Respective summarized findings of each study

The study by Shimizu and Osanai¹⁸ focused on home care nursing provided by highly trained nurses with expertise in palliative care (nurses with higher palliative care specialty [NHPCS]), who were not general home care nurses. GIS was used to visualize the distribution of home nursing stations and NHPCS (mapping) and perform quantitative analysis considering geographical conditions (buffer). The distribution of NHPCS differed 2.6 times between the studied prefectures;

26% of home nursing stations in Akita prefecture and 18% in Miyazaki prefecture had no facilities with NHPCS within a 10 km radius of the home nursing stations. Prefectures with few NHPCS had a higher percentage of facilities without NHPCS within a 10 km radius of the home nursing stations. That study proposed the need to increase the placement of NHPCS and suggested the role allotment based on understanding the uneven distribution of NHPCS.

The second study (Iizaka and Sanada¹⁹) examined the distribution of facilities with nurses certified in skin and excretory care (wound, ostomy, and continence nurses [WOCN]), who are also not general home care nurses. There were 100 facilities with WOCN and 741 home nursing stations at the municipal level in the Tokyo metropolitan area. GIS was used to visualize positional relationships (mapping) and evaluate proximity and coverage area (buffer) between facilities with WOCN and home nursing stations. In total, 31.6% of home nursing stations were located within 1 km of facilities with WOCN. Overall, the placement of home nursing stations and facilities with WOCN was uneven. That study highlighted the overall difficulty of access to a WOCN in the municipality and the need for solutions such as planned replacement of WOCN in areas that had few facilities with WOCN.

The study by Naito et al²⁰ examined the balance of supply and demand (as an appropriate placement) of medical and nursing care at a municipal level in Kanagawa prefecture. GIS was used to visualize the distribution of medical resources (mapping). That study examined the numbers of doctors and hospital beds for the population aged more than 75 years, the number of home nursing stations for the target patient population, and the degree of sufficiency of facilities by the number of users and capacity. Given the increase in the population aged

Table 1. Characteristics of the included studies.

AUTHOR	YEAR	TARGET AREA	TARGET SUBJECTS	GIS SOFTWARE	REASON FOR USING GIS (GIS METHOD)	DATA	CONTENT
Shimizu and Osanai ¹⁸	2014	Each prefecture in whole of Japan and each municipal level in 2 prefectures	Older adults	MANDARA	Visualization of the distribution of medical resources (mapping), performing quantitative analysis considering geographical conditions (buffer)	Location of medical facilities with specialist and home nursing stations (public information)	In prefectures with few specialists, fewer facilities with specialists were within a 10 km radius of a home nursing station
Iizaka and Sanada ¹⁹	2016	Each municipal level in Tokyo metropolitan area	Patients with pressure ulcer	ArcGIS	Visualization of positional relationship (mapping), evaluation of proximity and coverage area (buffer)	Location of medical facilities with specialist, home nursing station, regional medical care support hospitals (public information)	Facilities with specialist were found within 1 km of 31.6% of home nursing stations. The placement of the home nursing station and specialist facilities was mismatched
Naitou et al ²⁰	2016	Each municipal level in Kanagawa prefecture	Older adults (aged more than 75 years)	SIS	Visualization of the distribution of medical resources (mapping)	Information on estimated future population, medical and care facilities (public information)	Toward 2040, medical and nursing care resources (including home nursing stations) will be insufficient, with the degree of shortage varying among areas
Naruse et al ²¹	2017	Each municipal level in prefecture A	Older adults	ArcGIS	Visualization of placement of home nursing stations (mapping), evaluation of reachable area within 10 minutes (buffer)	Information on home nursing stations (public information), medical and care insurance claim information for the level of care needed for 4 to 5 patients (obtained from the prefecture)	The number of older adults living within 10 minutes by car from the nearest home nursing station was positively correlated with actual service use

GIS, geographic information systems.

more than 75 years, the analyses predicted a quantitative shortage of medical and nursing care resources by 2040. In particular, the overall shortage of home nursing stations was estimated to be 199 to 337 facilities, although there were 550 facilities at the time of the study. Throughout that prefecture, the size of the shortage varied by area, with the estimated shortage of home nursing stations in each region being 0 to 95 facilities. That study indicated the need to increase home care nursing and reconstruct the area definition by estimating the supply and demand of medical and nursing care.

Finally, Naruse et al²¹ examined the association between the geographic distribution of the older population and the use of home care nursing services at a municipal level in 1 prefecture. GIS was used to visualize the placement of home nursing stations (mapping) and evaluate the area reachable within 10 minutes (buffer). The older population living within 10 minutes (by car) from the nearest home nursing station was significantly

positively correlated with actual use of services (odds ratio: 1.938, 95% confidence interval: 1.265–2.967). However, ease of use for older people and business-related factors (eg, costs of visiting services) might have influenced the results. That study suggested managing the placement of home nursing stations to improve unmet home care nursing needs.

Discussion

We evaluated the current status of research focused on home care nursing based on GIS in Japan, where home care nursing is becoming increasingly important and an efficient use of limited medical resources is needed. Although home care nursing research appeared to fit with research using GIS,¹³ we found that the first study on home care nursing using GIS in Japan was published in 2014, and the number of studies overall remains small. The content of available studies could be classified in 2 themes “placement of specialists and home nursing

stations”^{18,19} and “placement of home nursing stations and target patients.”^{20,21}

The reason for the small number of studies remains unknown. We speculated that one reason may be a lack of open address data on home nursing stations. To our knowledge, information about home-visit nursing care providers was released in 2012 by the Ministry of Health, Labour and Welfare in the nursing care service information publication system. Another possible reason is that there are few GIS researchers in this field because of an overall scarcity of nursing researchers.²²

Examining the placement of home nursing stations and target patients by mapping and buffers using GIS is thought to be a reasonable approach. Given the features of home care nursing (eg, nurses visit patients’ homes^{1,7,8}), quantitatively clarifying the proximity of target patients’ homes to home nursing stations means that it is easier for patients to receive a service by choosing a closer home nursing station. Simultaneously, an advantage of this approach for home nursing stations is that they can also provide timely and efficient services for target patients. Examining the placement of specific specialist professionals (eg, NHPCS and WOCN^{18,19}) and home nursing stations is also of interest. As specialist care similar to that available in hospitals is not always able to be provided at home,¹⁹ such GIS-based approaches can be useful to promote the proper distribution of specialist care at the community level.

Most studies included in this review were conducted in community areas at the prefectural and municipal levels, rather than considering the whole of Japan. The target subjects in 3 of the 4 studies were older people. The subjects with pressure ulcers in the study of Iizaka and Sanada¹⁹ were also assumed to be older people with malnutrition and/or a bedridden state. Given Japan’s super-aged society,² the development of a community-based integrated care system at the municipality level³ is required. This context is thought to have influenced the target areas and subjects of the 4 studies reviewed.

GIS-based research on home care nursing should be further conducted in diverse concepts in the near future, for example, a business-related perspective is required for home care nursing.^{8,21} The study of Naruse et al²¹ examined the distance between a home nursing station and a patient’s home. This allows management efficiency to be calculated by considering the type of service actually provided, actual status of human resources, cost, and needs. As home care nursing requires cooperation with other services (eg, welfare and voluntary resources),^{6,7} research should include a combination of various services in the community (like the study by Naitou et al²⁰ that examined a combination of medical and nursing care). Furthermore, we suggest that conducting such studies in a larger number of regions in units of municipalities and considering local stakeholders would support the development of a community-based integrated care system that includes home care nursing provision. Whereas one of the reviewed studies

used patient information (Naruse et al²¹), the other studies used public information. Research using patient information will produce more detailed implications.

This review had some limitations. Particularly, there were few studies eligible for inclusion in this review. In addition, most studies focused on specific areas (eg, 1 prefecture). Therefore, caution is needed in generalizing the findings to other areas (including overseas countries). Future research should be conducted to increase the number of studies that target diverse regions and subjects.

Conclusions

There is currently a paucity of GIS-based research on home care nursing in Japan. “Placement of specialist and home nursing station” and “placement of home nursing stations and target patients” were the key themes in the selected studies. As all the identified studies examined the community areas with an aged population, it may be a hint to consider community-based integrated care systems, including home care nursing, in Japan. More GIS-based research on home care nursing is required.

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Author Contributions

TaK searched the literature and wrote the manuscript. KK designed the study and supervised writing of the manuscript. KH, SK and ToK reviewed the literature and reviewed the manuscript.

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