



Is there a difference between urban and rural areas in the disposal of home medical care waste? 13 years of nation-wide repeated cross-sectional study in Japan

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Received: 29 May 2020 / Accepted: 22 October 2020 / Published online: 6 November 2020
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Abstract

Home medical care (HMC) is advancing not only in Japan but also throughout the world. In Japan, HMC waste is legally classified as municipal waste. Nevertheless, some municipalities do not collect some or all the HMC waste because of fear of infection. Therefore, this study was conducted to clarify the following two issues: First, have the municipalities made progress in collecting and appropriate disposal of HMC waste in the past 13 years? Second, is there a difference between a large city and a small city in terms of appropriate disposal progress? A total of 687 municipalities published the treatment of HMC waste. Currently, 42 municipalities collected all HMC waste. 236 municipalities were collecting HMC waste except for self-injection needle. 117 municipalities were collecting HMC waste except for self-injection needle and Syringe. The collection status of HMC waste was better in cities with high population than in cities with low population. HMC waste collection status was progressed over 13 years. However, more than 60% of the municipality staff stated that they could not avoid being anxious about infection caused by HMC waste. We suggest that providing HMC waste education to the municipalities wherein these efforts have not yet progressed is important.

Keywords Municipality waste collection · Home medical care waste · Municipality staff education · Japan

Introduction

Home medical care (HMC) is progressing not only in Japan but also throughout the world. In fact, the number of HMC cases in Japan increased sharply in the past 30 years. Table 1 presents the annual trends in the number of HMC cases according to type. It can be observed that the number of cases of HMC performed in 2016 was approximately 1.555 million, which was approximately five times the number in 1996 (approximately 343,000) and that in 2006

(approximately 815,000), indicating an increase of nearly two-fold [1]. The number of HMC cases was the highest for self-injection at home, followed by home continuous positive pressure breathing and home oxygen therapy. Researchers anticipate that the number will increase in the future.

An important issue not only for medical personnel but also for patients and society is the appropriate treatment of HMC waste. Studies investigating HMC sharp object waste in the United States [2, 3] and HMC waste infection control in the United Kingdom [4, 5] generally recommended that sharp or infectious items be disposed of by doctors or nurses, and it has been particularly emphasized that needles and infectious materials should not be handled by non-medical personnel. Further studies also recommended that all patients be given professional HMC education on the appropriate handling of HMC waste [2, 6–8]. However, irrespective of these concerns and recommendations, limited research on HMC waste collection exists.

In Japan, municipalities are responsible for the treatment of HMC waste generated by home visits as it is legally classified as municipal waste [9, 10]. Because of increasing concerns regarding the amount of waste collection associated

Electronic supplementary material The online version of this article (<https://doi.org/10.1007/s10163-020-01132-0>) contains supplementary material, which is available to authorized users.

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Table 1 Trends in the number of HMC

Years	1991	1996	2001	2006	2011	2016
Self-injection	185,919	279,046	472,504	541,060	701,212	906,843
Continuous positive pressure breathing	–	–	2251	66,447	203,941	382,472
Oxygen therapy	16,781	41,165	87,434	93,021	122,007	126,279
Self-catheterization	4942	18,776	21,199	47,711	45,314	51,308
Treatment for bedridden patients	2950	15,632	20,464	29,916	32,627	31,048
Peritoneal perfusion	2180	5239	8623	8915	8731	9743
Others	1125	5258	15,887	28,274	51,547	47,353
Total	213,897	343,756	628,362	815,344	1,165,379	1,555,046

Values indicate the actual number of each HMC type

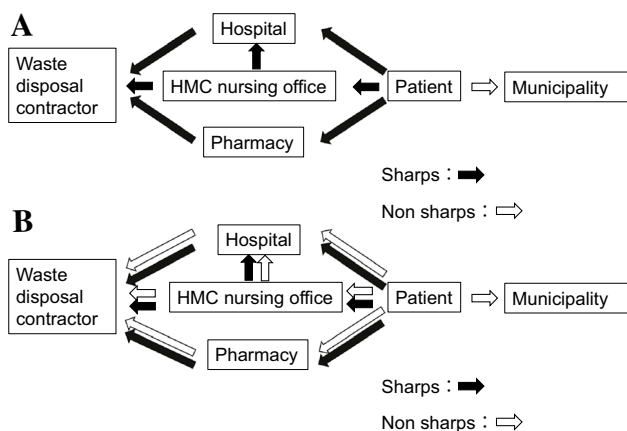


Fig. 1 **a** Ideal HMC waste disposal route in Japan. **b** Current HMC waste disposal routes in some Japanese municipalities. The black arrows indicate the flow of sharp waste such as a needle, and the white arrows indicate the flow of non-sharp waste

with HMC, “The Exploratory committee for ideal way of treatment of Home medical waste” made the following recommendations as the most desirable method in 2008. (1) Sharp items such as injection needles are brought to medical institutions by medical personnel or patients/family and treated as infectious waste; (2) other non-sharp items are treated by municipalities [11]. Following these recommendations, some large municipalities have begun collecting HMC waste and also developed guidelines for handling of HMC waste [12–14]. Nevertheless, some municipalities do not collect some or all the HMC waste because of fear of infection [15–17].

The ideal disposal route for HMC waste is depicted in Fig. 1a. However, some existing municipalities do not collect non-sharp tubes and plastic bags (Fig. 1b). Municipalities are required to promote the direction of the right-pointing blue arrow (from Patient to Municipality) indicated in Fig. 1b, but small- and medium-sized municipalities, in particular, cannot be said to be progressing sufficiently at present such as not collecting non-sharp tubes and plastic bags (Fig. 1b).

Earlier, we demonstrated indirectly that municipalities are making steady progress in the appropriate disposal of medical waste generated at home [18]. Conversely, differences exist in the approach toward HMC waste disposal depending on the size of the city, and a concern exists that these differences may have widened in large and small cities in recent years [18]. In small cities that do not deal with appropriate disposal of HMC waste, home health care nurses and doctors bear the burden. In this situation, appropriate waste treatment will be implemented only in large cities with large populations, and the burden on nurses and doctors will only increase in rural and small cities where the proportion of elderly individuals is high. However, these studies are conducted for medical professionals such as doctors and nurses, and the situation of municipalities has not been directly investigated. Therefore, this time, we conducted research on municipalities. Therefore, this study was conducted to clarify the following two issues: First, have the municipalities made progress in collecting and appropriate disposal of HMC waste in the past 13 years? Second, is there a difference between a large city and a small city in terms of appropriate disposal progress?

Methods

Website survey

The treatment of HMC waste in all municipalities (1741 in total) across the nation was confirmed from the website. In each municipality, researchers confirmed whether the treatment of HMC waste is described in the municipal waste treatment plan.

Questionnaire survey

A questionnaire survey on HMC waste was conducted in 200 municipalities nationwide (about 1/10 of the municipalities in Japan). The questionnaire addressed whether the municipality included the treatment of HMC waste in its waste

treatment plan and whether the staff members were worried about HMC waste.

Comparison with 13 years earlier

Results of both the website survey and the questionnaire survey were compared with the results obtained 13 years earlier, to evaluate the progress made in the municipalities in the treatment of HMC waste.

Statistical analysis

McNemar’s test was used to compare the number of municipalities that collected waste according to the item of HMC waste between 2006 and 2019. A *p* value < 0.05 was considered to indicate a significant difference. The SPSS version 24 software was used for statistical analyses.

Results

Availability of HMC waste disposal information on the website

The websites of the 1741 municipalities were checked to find whether any information exists regarding the treatment of HMC waste. A total of 687 municipalities (39.5%) published the details regarding the treatment of HMC waste. Municipalities with a large population that published information

on the treatment of HMC waste constituted a higher proportion (Table 2).

Current status of HMC waste collection by municipalities

Based on the results of the 687 municipalities that published information on HMC waste treatment on the website, the collection status of HMC waste was confirmed. The waste collection status was divided into six categories. Category 1 was a municipality collecting pen-type self-injection needles, syringes, bags, tubes, absorbent cotton, and gauze. Category 2 was a municipality collecting syringes, bags, tubes, absorbent cotton, and gauze. Category 3 included municipalities that collected bags, tubes, absorbent cotton, and gauze. Category 4 comprised municipalities that collected absorbent cotton and gauze. Category 5 included municipalities that did not collect any HMC waste. Category 6 was a municipality where HMC waste items were unknown. Based on this classification, of the 687 municipalities, 42 (6.1%) were classified into category 1, 236 (34.4%) were classified into category 2, 117 (17.0%) were classified into category 3, 46 (6.7%) were classified into category 4, 232 (33.8%) were classified into category 5, and 14 (2.0%) were classified into category 6 (Table 3). Based on the government statistics (Japan Ministry of Internal Affairs and Communications Statistics Bureau, 2018), local governments are classified according to population size as a large-sized city with a population size of ≥ 200,000, a middle-sized city with a

Table 2 Number of municipalities published on the website regarding how to treat HMC waste

	Published		Not published		Total	
Large sized city 200,000 ≤	114	(87.7)	16	(12.3)	130	(100)
Middle sized city 50,000 ≤	259	(61.7)	161	(38.3)	420	(100)
Small sized city < 50,000	314	(26.4)	877	(73.6)	1191	(100)
Total	687	(39.5)	1054	(60.5)	1741	(100)

Values indicate the actual number of cities (percentage by city category) in according to the city population

Table 3 Collection status of HMC waste by item in 687 municipalities

HMC waste collection category	1	2	3	4	5	6	
Pen type self-injection needle	Y	N	N	N	N	UN	
Syringe	Y	Y	N	N	N		
Bags, tubes	Y	Y	Y	N	N		
Absorbent cotton and gauze	Y	Y	Y	Y	N		
2019 all municipalities	42 (6.1)	236 (34.4)	117 (17.0)	46 (6.7)	232 (33.8)	14 (2.0)	687 (100)
Large sized city 200,000 ≤	9 (7.9)	68 (59.6)	18 (15.8)	6 (5.3)	12 (10.5)	1 (0.9)	114 (100)
Middle sized city 50,000 ≤	14 (5.4)	89 (34.4)	49 (18.9)	15 (5.8)	84 (32.4)	8 (3.1)	259 (100)
Small sized city < 50,000	19 (6.1)	79 (25.2)	50 (15.9)	25 (8.0)	136 (43.3)	5 (1.6)	314 (100)

Value indicate the actual number of cities (percentage of city category) in according to city population

Collection status: Y: yes, N: no, UN: unknown

population size of $\geq 50,000$ and $< 200,000$, and a small-sized city with a population size of $< 50,000$. The waste collection status was similarly classified according to the population size of the local governments (Table 3).

Changes in HMC waste collection status over the past 13 years

We investigated the changes in the collection status of HMC waste. Among the 687 municipalities examined in this study, a statistically significant increase was found in the percentage of municipalities that collected HMC waste over the

past 13 years in categories 1 and 3. Conversely, this percentage statistically significantly decreased in categories 4 and 5 (Fig. 2).

Next, we examined these changes according to population size. In large-sized cities, the percentage of municipalities that collected HMC waste was statistically significantly increased in categories 2 and 3. However, this percentage statistically significantly decreased in categories 4 and 5. In middle-sized cities, a statistically significant increase occurred in the percentage of municipalities that collected HMC waste in categories 1, 2, and 3, whereas this percentage was statistically significantly decreased in categories 4

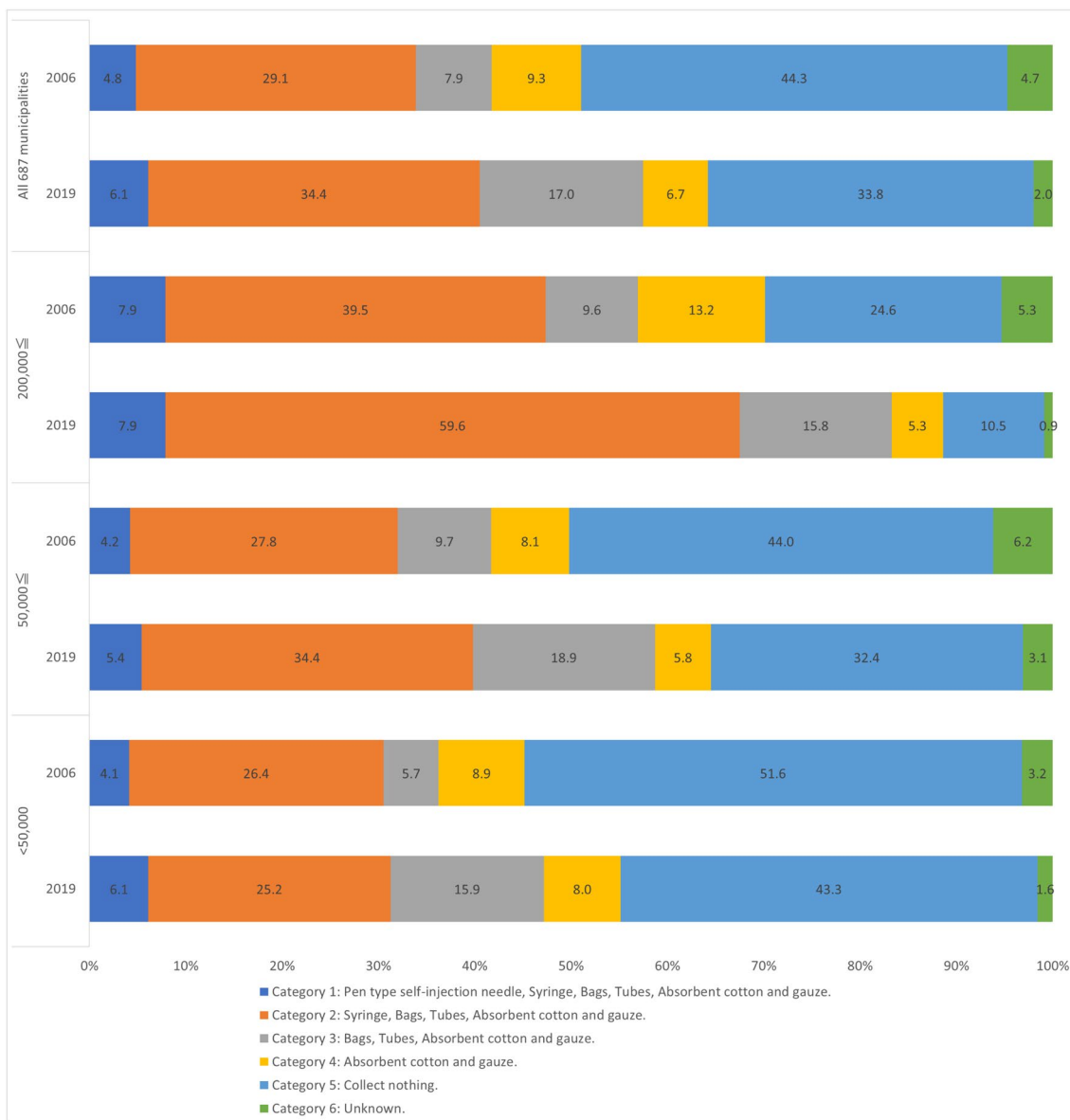


Fig. 2 Percentage of HMC waste collection by municipalities according to the item in 2006 and 2019. At the top are all 687 municipalities surveyed. From the second, cities with a population of 200,000

or more, cities with a population of 50,000 or more, and cities with a population of $< 50,000$. The years that were studied are indicated in 2006 and 2019

and 5. In small-sized cities, the percentage of municipalities collecting HMC waste statistically significantly increased in categories 1 and 3 but decreased in categories 2, 4, and 5 (Fig. 2).

Whether the treatment of HMC waste is included in the municipal waste treatment plan

The questionnaire was answered by 138 of the 200 municipalities (69.0%). A total of 44 (32.1%) municipalities mentioned that they included the treatment of HMC waste in their municipal waste treatment plan. Before 13 years, only 9 of these 138 municipalities (6.5%) included the treatment plan for HMC waste, which indicated a considerable progress (Fig. 3).

Concerns regarding the dangers of non-sharp HMC waste

Of the 138 municipalities that answered the questionnaire, 83 (60.1%) stated that they were concerned about accidents

and infections, even if they were non-sharp HMC waste (Table 4).

Discussion

In the present study, we followed up 13 years of data on the progress made in the collection and handling of HMC waste. In the website survey, 687 (39.5%) municipalities published details about the disposal of HMC waste on their website. According to population size, 114 of 130 (87.7%) large-sized municipalities with > 200,000 population published information regarding the treatment of HMC waste, whereas in small-sized municipalities with a population size of < 50,000, only 314 of 1191 (26.4%) municipalities published this information. The rate of publishing on the website was in accordance with the population size, i.e., the higher the population, the higher the rate of publishing on the website regarding the disposal of HMC waste. One of the reasons is that more staff members in charge of waste management were present in large-sized cities, and they might also exhibit more knowledge. Another reason

Fig. 3 The number of municipalities that described HMC waste treatment in the municipal waste treatment plan. The numbers in the figure show the actual numbers for 2006 and 2019 for the 138 cities studied

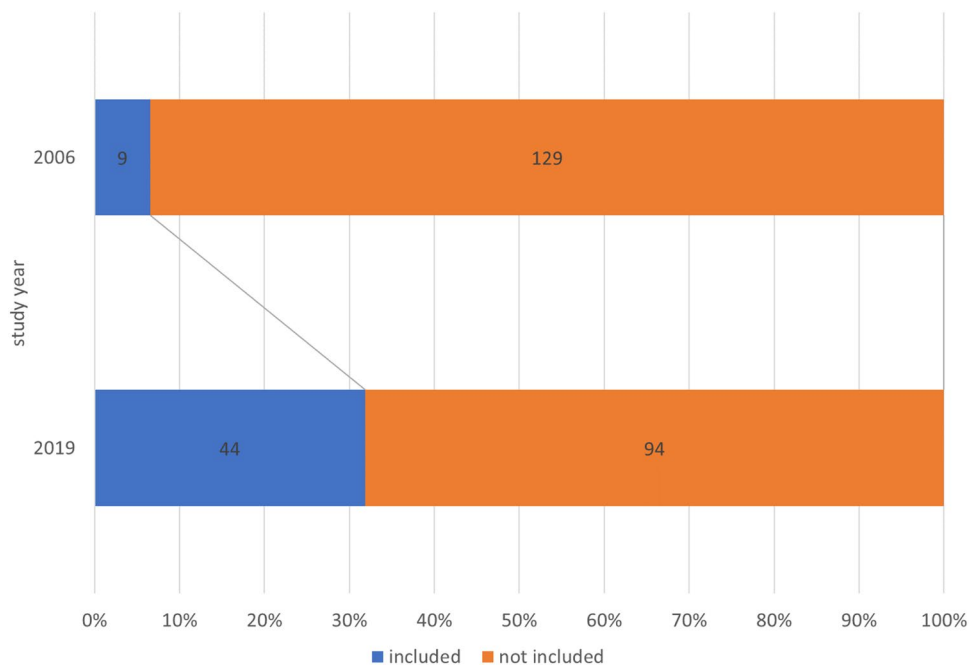


Table 4 Concerns on the dangers of non-sharp HMC waste

We believe that non-sharp home medical waste is actually a risk of infection	8	(5.8)
We consider that non-sharp home medical waste is not dangerous	11	(8.0)
Even non-sharp HMC waste is concerned about accidents and infections	83	(60.1)
No opinion	36	(26.1)
Total	138	(100.0)

Value indicate the actual number (percentage) of the 138 cities surveyed

is that the number of inquiries from citizens could be high, and hence, this information was published on the website to reduce the burden of answering individual questions. Conversely, in small-sized cities, the number of inquiries from citizens was small, and responding individually might be possible.

Regarding the collection status of HMC waste, the website survey revealed that 6.1% of municipalities collected all HMC waste, including sharp objects, and 58.1% of municipalities collected some HMC waste other than sharp objects. This indicated an increase of 13.1%, compared with the baseline survey (Fig. 2). Whether this progress is sufficient or inadequate remains controversial. In this regard, the results of this survey were examined according to population size. The categories of HMC waste collection that were statistically significantly different from the baseline survey included syringes in large-sized cities with a population size of $\geq 200,000$ and syringes in municipalities with a population size of $\geq 50,000$ and $< 200,000$. The category of bags and tubes was found in municipalities with a population size of $< 50,000$. This indicates that larger cities are beginning to collect HMC waste, which is considered to be more dangerous. In other words, it can be observed that the collection of HMC waste is gradually progressing from large-sized cities to small- and medium-sized cities. Hence, why is the collection of HMC waste, which is relatively dangerous in large-sized cities, progressing? One possible explanation for this is the understanding of the municipality staff about HMC waste. As shown in Table 4, 60.1% of all municipalities answered the survey. Even non-sharp HMC waste is vaguely related to accidents and infections, due to which the psychological resistance associated with collecting this waste cannot be eliminated. According to population size, the proportion of no collecting HMC waste in 2019 was 10.5% for municipalities with a population size of $\geq 200,000$, compared to 32.4% for cities with a population size of $\geq 50,000$ and $< 200,000$ and 43.3% for municipalities with a population size of $< 50,000$. Therefore, understanding this situation may be necessary for the local government officials to promote the collection of HMC waste. Furthermore, regarding the waste category shown in Fig. 2 and Table 3, it is desirable to confirm that medical personnel are collecting sharp materials. In this regard, we also conducted a survey of visiting medical institutions. A total of 183/206 medical institutions responded that doctors or nurses collected sharp waste. However, because visiting doctors visited at multiple municipalities, it could not be ascertained whether these were the same municipalities that were included in the survey. Therefore, a further survey is needed in the future.

It is important to include an HMC waste treatment plan in the municipal waste treatment plan. The left-pointing arrow in Fig. 1 cannot be realized without cooperation between the parties. Among the parties involved, the lack

of understanding and cooperation from the municipalities is a problem for treating home medical waste.

This point was stated by only 9 municipalities in the baseline survey but by 44 municipalities in the follow-up survey (Fig. 3). This represents a great development. However, 94 municipalities have not yet been included in the treatment plan. This shows that promoting education is necessary so that these local governments can describe appropriate HMC waste disposal in the treatment plan in the future.

Compared with 2006 [19], the progression in HMC waste collection by the municipalities increased. However, more than 60% of the municipality staff responded that they could not avoid the anxiety about infection caused due to HMC waste and the psychological resistance when collecting it, and it is considered that the municipality is an obstacle to collecting HMC waste. In total, 33.8% of the municipalities we surveyed did not collect HMC waste in 2019. 68.1% of the municipalities we surveyed did not mention information on HMC waste treatment in their municipal waste treatment plans.

Finally, the limitations of research need to be stated. We investigated the status of HMC waste collection in municipalities all over Japan through a website survey. The number is 687, which is 39.5% of the national total. The status of municipalities not published on the website is unknown. Perhaps the situation for municipalities not published on the website may be worse. We suggest that providing HMC waste education to the municipalities wherein these efforts have not yet progressed is important.

Acknowledgements We thank all the municipality staff for their cooperation in the survey.

Funding This study was supported by the Yuumi Memorial Foundation for Home Health Care (2006–2007 and 2018–2019).

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