

## Improving Hand Hygiene Adherence in Healthcare Workers Before Patient Contact: A Multimodal Intervention in Four Tertiary Care Hospitals in Japan

Akihiko Saitoh, MD, PhD<sup>1\*</sup>, Kiyomi Sato, RN<sup>2</sup>, Yoko Magara, RN<sup>2</sup>, Kakuei Osaki, RN<sup>3</sup>, Kiyoko Narita, RN<sup>4</sup>, Kumiko Shioiri, RN<sup>5</sup>, Karen E Fowler, MPH<sup>6</sup>, David Ratz, MS<sup>6</sup>, Sanjay Saint, MD, MPH<sup>6,7</sup>

<sup>1</sup>Department of Pediatrics, Niigata University Graduate School of Medical and Dental Sciences, Niigata Japan; <sup>2</sup>Department of Nursing, Niigata Saiseikai Daini Hospital, Niigata, Japan; <sup>3</sup>Department of Nursing, Niigata City General Hospital, Niigata, Japan; <sup>4</sup>Department of Nursing, Nagasaki Red Cross Medical Center, Niigata, Japan; <sup>5</sup>Department of Nursing, Niigata Prefectural Shibata Hospital, Niigata, Japan; <sup>6</sup>Center for Clinical Management Research, VA Ann Arbor Healthcare System, Ann Arbor, Michigan; <sup>7</sup>Department of Internal Medicine, University of Michigan Medical School, Ann Arbor, Michigan.

**BACKGROUND:** Hand hygiene is key to preventing healthcare-associated infection and the spread of respiratory viruses like the novel coronavirus that causes COVID-19. Unfortunately, hand hygiene adherence of healthcare workers (HCWs) in Japan is suboptimal according to previous studies.

**OBJECTIVES:** Our objectives were to evaluate hand hygiene adherence among physicians and nurses before touching hospitalized patients and to evaluate changes in hand hygiene adherence after a multimodal intervention was implemented.

**DESIGN, SETTING, AND PARTICIPANTS:** We conducted a pre- and postintervention study with HCWs at four tertiary hospitals in Niigata, Japan. Hand hygiene observations were conducted from June to August 2018 (preintervention) and February to March 2019 (postintervention).

**INTERVENTION:** The multimodal hand hygiene intervention recommended by the World Health Organization was tailored to each hospital and implemented from September 2018 to February 2019.

**MAIN OUTCOMES AND MEASURES:** We observed hand hygiene adherence before touching patients in each

hospital and compared rates before and after intervention. Intervention components were also evaluated.

**RESULTS:** There were 2,018 patient observations preintervention and 1,630 postintervention. Overall, hand hygiene adherence improved from 453 of 2,018 preintervention observations (22.4%) to 548 of 1,630 postintervention observations (33.6%;  $P < .001$ ). Rates improved more among nurses (13.9 percentage points) than among doctors (5.7 percentage points). Improvement varied among the hospitals: Hospital B (18.4 percentage points) was highest, followed by Hospitals D (11.4 percentage points), C (11.3 percentage points), and Hospital A (6.5 percentage points).

**CONCLUSIONS:** A multimodal intervention improved hand hygiene adherence rates in physicians and nurses in Niigata, Japan; however, further improvement is necessary. Given the current suboptimal hand hygiene adherence rates in Japanese hospitals, the spread of COVID-19 within the hospital setting is a concern. *Journal of Hospital Medicine* 2020;15:262-267. © 2020 Society of Hospital Medicine

In the era of multidrug resistant organisms spreading to healthcare facilities, as well as in the community, prevention of healthcare-associated infections (HAIs) has become one of the most important issues in the world. HAIs impact morbidity and mortality of patients, increase healthcare costs,<sup>1,2</sup> and are associated with a longer length of stay in the hospital.<sup>3,4</sup> In Japan, HAIs are a salient problem; more than 9% of patients admitted to the intensive care unit (ICU) developed an infection during their ICU stay,<sup>5</sup> and the numbers of multidrug resistant

organism isolates causing HAIs have been increasing annually.<sup>6</sup>

Hand hygiene is the most important strategy for preventing the spread of MDROs and reducing HAIs.<sup>7</sup> Heightened attention to hand hygiene has occurred because of the recent global outbreak of coronavirus disease 2019 (COVID-19), which first appeared in Wuhan, China.<sup>8</sup> Because no proven antiviral or vaccine is currently available for the disease, hand hygiene, appropriate cough etiquette, and physical distancing, including school closures, are the only way to prevent spread of the illness.<sup>9,10</sup> The virus appears to be highly contagious and spread by droplet or contact routes. The spread of COVID-19 in healthcare facilities has been significant,<sup>11</sup> and it could be a source of further spread of the disease in the community.

Unfortunately, hand hygiene adherence remains low in most settings.<sup>12</sup> The World Health Organization (WHO) created a strategy to improve hand hygiene adherence,<sup>13</sup> which has been implemented in many countries.<sup>14</sup> This strategy consists of five

\*Corresponding Author: Akihiko Saitoh, MD, PhD;  
Email: asaitoh@med.niigata-u.ac.jp; Telephone: 81-25-227-2222.

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TABLE 1. Hospital Characteristics, Hand Hygiene Infrastructure, and Existing Activities to Encourage HCW Hand Hygiene in Four Tertiary Care Hospitals

	Hospital A	Hospital B	Hospital C	Hospital D
Hospital characteristics				
Number of beds	676	478	425	605
Number of employees	1,529	720	835	1,266
Number of physicians	198	93	95	131
Number of nurses	839	45	452	708
Infrastructure for hand hygiene				
AHR	Yes (in some areas)	Yes	Yes	Yes (in some areas)
Wash basin	Yes	No	Yes	Yes
Portable AHR	Yes	No	Yes	No
Existing hand hygiene activities*				
Periodic educational activities <sup>1</sup>	Yes	Yes	Yes (only new employees)	Yes
Poster campaign <sup>2</sup>	Yes	Yes	No	No
Routine evaluation for hand hygiene adherence <sup>3</sup>	Yes (only 1 ward)	Yes	No	Yes
Direct observation <sup>4</sup>	Yes (only 1 ward)	Yes	Yes (in some areas)	Yes (in some areas)
Monitoring of AHR consumption <sup>5</sup>	Yes	Yes	Yes	Yes

\*All activities were designated for all HCWs unless otherwise specified.

<sup>1</sup>A hand hygiene seminar or lecture in the unit or hospital at least once per year.

<sup>2</sup>Creating and displaying a new poster to facilitate hand hygiene in the unit or hospital.

<sup>3</sup>Periodic monitoring of hand hygiene.

<sup>4</sup>Direct observation of HCWs' hand hygiene practices.

<sup>5</sup>Monitoring the amount of AHR consumption as a parameter for HCWs' hand hygiene practices.

Abbreviations: AHR, alcohol-based hand rub; HCW, healthcare worker.

key components: (1) system change, (2) training/education, (3) evaluation and feedback, (4) reminders in the workplace, and (5) institutional safety climate.<sup>13</sup> Implementing a multimodal intervention including these five elements has increased hand hygiene adherence among healthcare workers (HCWs) and appears to reduce HAIs in different locations.<sup>15-17</sup> Improving hand hygiene practice among HCWs is considered one of the most important ways to decrease the incidence of HAIs.<sup>15,18,19</sup>

There are two types of practice for hand hygiene: either hand washing with soap and water or using alcohol-based hand rub (AHR). The former requires water, soap, a sink, and paper towels, whereas the latter requires only hand rub, which is easy to use and requires one-third the length of time as the former.<sup>20</sup> Therefore, AHR is strongly recommended, especially in acute and intensive care settings in hospitals, which require urgent care of patients. Importantly, previous studies demonstrated that greater use of AHR resulted in significant reductions in HAIs.<sup>7,14</sup>

In Japan, the data related to hand hygiene adherence is limited. Previous studies at four hospitals in different regions of Japan demonstrated that hand hygiene rates were suboptimal<sup>21</sup> and lower than reported adherence rates from other international studies.<sup>14</sup> One study at three hospitals showed rates could be improved by a multimodal intervention tailored by each institution.<sup>22</sup> A 5-year follow-up study demonstrated the sustainability of the multimodal intervention<sup>23</sup>; however, hand hygiene adherence rates remained low at approximately 32%.

We hypothesized that perhaps focusing attention on just one single region (or prefecture) could boost hand hygiene rates. Ni-

igata prefecture is located 200 miles north of Tokyo and is the largest prefecture facing the Japan Sea. There are five major tertiary hospitals in Niigata, and they communicate frequently and discuss infection control issues as a group. To investigate hand hygiene adherence before touching patients, and to evaluate the improvement of hand hygiene adherence induced by a multimodal intervention, we performed a pre- and postintervention study among HCWs at four of these tertiary care hospitals in Niigata.

## METHODS

### Participating hospitals

Four tertiary care hospitals in Niigata, Japan, volunteered to participate in the study. The characteristics of the four participating hospitals are summarized in Table 1. All hospitals are public or community based. Hospital A included two units, consisting of a cardiovascular-cerebral ICU and an emergency department (ED), and Hospitals B, C, and D included various units containing surgical or medical wards, an ICU, or an ED. All four hospitals have at least one designated infection-prevention nurse and an infection-prevention department. In addition, there is an infection control network system among the hospitals, and they communicate well to update the information related to local, domestic, or global infectious diseases through regular seminars and by distributing and exchanging electronic communication.

### Preintervention

The preintervention infrastructure and existing activities to improve HCW hand hygiene in each hospital are summarized

TABLE 2. Adoption of Suggested Study Intervention Components in Each Hospital

Interventions <sup>*</sup>	Hospital A	Hospital B	Hospital C	Hospital D
1. Feedback regarding hand hygiene adherence during preintervention period	X	X	X	X (for ICU nurses)
2. AHR implementation				
2-1. Introduction of self-carry AHR		X	X	X (for nurse and nurse's aide)
2-2. Placement of AHR at new location		X (ICU, at bedside)		X (both sides of bed)
2-3. Monitoring AHR use with feedback for HCWs			X	
2-4. New, moisturizing products		X <sup>1</sup>		
3. Direct observation of, and feedback regarding, hand hygiene	X			X
4. Poster	X			
5. A 1-month campaign	X <sup>2</sup>	X		
6. Seminar				X (for ICU HCW and nurses)
7. Creation of a hand hygiene handbook			X (for nurses)	
8. Feedback regarding hand hygiene adherence during intervention		X		X (for ICU nurses)
9. Others			Test of hand hygiene knowledge; Demonstration of culture results of MRSA carrier	

<sup>\*</sup>All interventions were designated for all HCWs unless otherwise specified.

<sup>1</sup>For HCWs who preferred products that caused less skin irritation than the current products.

<sup>2</sup>Part of the 1-month campaign was a contest for senryu (humorous 17-syllable poem).

Abbreviations: AHR, alcohol-based hand rub; HCW, healthcare worker; ICU, intensive care unit; MRSA, methicillin-resistant *Staphylococcus aureus*.

in Table 1. These activities were developed by each individual hospital and had been in place for at least 6 months before the study intervention. All hospitals used AHR and did direct observation for hand washing in designated wards or units and monitoring of AHR consumption; however, Hospital B did not have a wash basin in each room and no use of portable AHR. Preintervention hand hygiene data were collected from June to August 2018.

### Intervention

To improve hand hygiene adherence, we initiated a multimodal intervention from September 2018 to February 2019 based on WHO recommendations<sup>13</sup> and the findings from prior hand hygiene studies.<sup>22</sup> Each facility was provided the same guidance on how to improve hand hygiene adherence and was asked to tailor their intervention to their settings (Table 2 and Appendix Figure). Suggested interventions included feedback regarding hand hygiene adherence observed during the preintervention period, interventions related to AHR, direct observation of and feedback regarding hand hygiene, new posters promoting hand hygiene in the workplace, a 1-month campaign for hand hygiene, seminars for HCWs related to hand hygiene, creation of a handbook for education/training, feedback regarding hand hygiene adherence during the intervention period, and others. The infection control team at each hospital designed

the plans and strategies to improve hand hygiene adherence. Postintervention data were collected from February 2019 to March 2019.

### Observation of Hand Hygiene Adherence

Hand hygiene adherence before patient contact was evaluated by board-certified infection control nurses. To reduce observation bias, external nurses from other participating hospitals conducted the observations. To minimize intraobserver variation, the same training as the previous study in Japan<sup>21</sup> was provided. Hand hygiene observations were usually performed during the day Monday to Friday from 8 AM to 1 PM because of observers' availability.

Use of either AHR or soap and water before patient contact was defined as appropriate hand hygiene.<sup>24,25</sup> Hand hygiene adherence before patient contact for each provider-patient encounter was observed and recorded using a data collection form used in the previous studies.<sup>19,26</sup> The following information was obtained: unit name, time of initiation and completion of observations, HCW type (physician or nurse), and the type of hand hygiene (ie, AHR, hand washing with soap and water, or none). The observers kept an appropriate distance from the observed HCWs to avoid interfering with their regular clinical practice. In addition, we informed HCWs in the hospital that their clinical practices were going to be observed; however,

they were not informed their hand hygiene adherence was going to be monitored.

### Statistical Analysis

Overall hand hygiene adherence rates from the pre- and postintervention periods were compared based on hospitals and HCW subgroups. The Pearson's chi-square test was used for the comparison of hand hygiene adherence rates between pre- and postintervention periods, and 95% CIs were estimated using binomial distribution. Poisson regression was used to look at changes in hand hygiene adherence with adjustment for HCW type. A two-tailed *P* value of  $<.05$  was considered statistically significant. The study protocol was reviewed and approved by the ethics committees at all participating hospitals.

## RESULTS

### Overall Changes

In total, there were 2,018 and 1,630 observations of hand hygiene during the preintervention and postintervention periods, respectively. Most observations were of nurses: 1,643 of the 2,018 preintervention observations (81.4%) and 1,245 of the 1,630 postintervention observations (76.4%).

Findings from the HCW observations are summarized in Figure A. The overall postintervention hand hygiene adherence rate (548 of 1,630 observations; 33.6%; 95% CI, 31.3%-35.9%) was significantly higher than the preintervention rate (453 of 2,018 observations; 22.4%; 95% CI, 20.6%-24.3%;  $P < .001$ ). This finding persisted after adjustment for the type of HCW (nurse vs physician), with proper hand hygiene adherence occurring 1.55 times more often after the intervention than before (95% CI, 1.37-1.76;  $P < .001$ ). The overall improvement in hand hygiene adherence rates in the postintervention period was seen in all four hospitals (Figure B). However, the hand hygiene adherence rates of nurses in Hospitals C and D were lower than those in Hospitals A and B both before and after the intervention.

Use of AHR was the dominant appropriate hand hygiene practice vs hand washing with soap and water. Of those that practiced appropriate hand hygiene, the rate of AHR use was high and unchanged between preintervention (424 of 453; 93.6%) and postintervention periods (513 of 548; 93.6%;  $P = .99$ ).

### Changes by HCW Type

The rates of hand hygiene adherence in both physicians and nurses were higher in the postintervention period than in the preintervention period. However, the improvement of hand hygiene adherence among nurses—from 415 of 1,643 (25.2%) to 487 of 1,245 (39.1%) for an increase of 13.9 percentage points (95% CI, 10.4-17.3)—was greater than that in physicians—from 38 of 375 (10.1%) to 61 of 385 (15.8%) for an increase of 5.7 percentage points (95% CI, 1.0-8.1;  $P < .001$ ; Figure B). In general, nurse hand hygiene adherence was higher than that in physicians both in the preintervention period, with nurses at 25.2% (95% CI, 23.2%-27.4%) vs physicians at 10.1% (95% CI, 7.1%-13.2%;  $P < .001$ ), and in the postintervention period, with nurses at 39.1% (95% CI, 36.4%-41.8%) vs physicians at 15.8% (95% CI, 12.2%-19.5%;  $P < .001$ ).

### Changes by Hospital

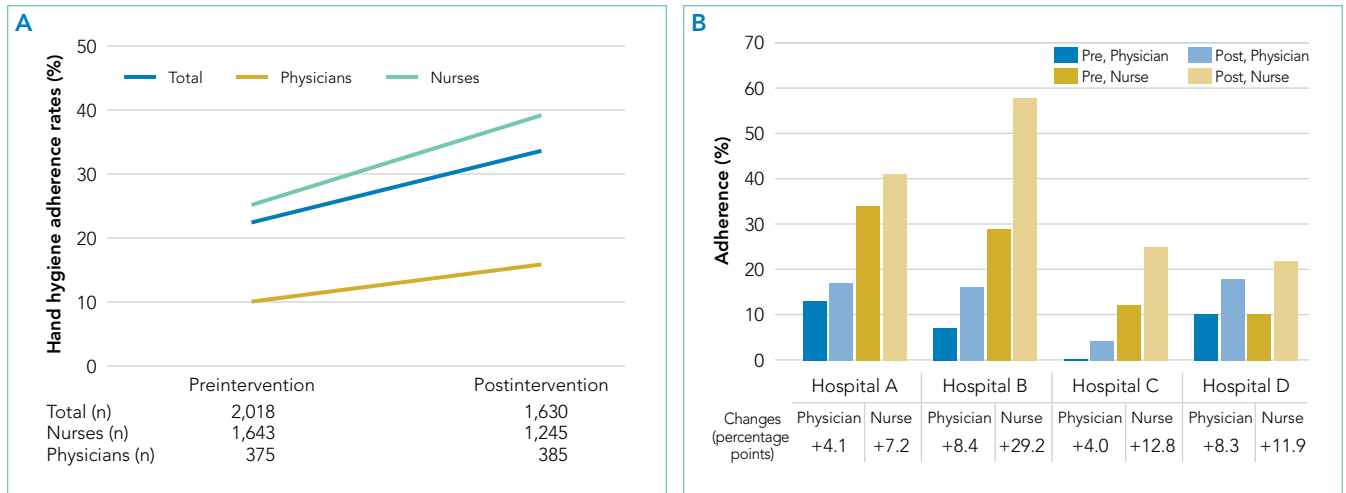
Overall, improvement of hand hygiene adherence was observed in all hospitals. However, the improvement rates differed in each hospital: They were 6.5 percentage points in Hospital A, 11.3 percentage points in Hospital C, 11.4 percentage points in Hospital D, and 18.4 percentage points in Hospital B. Hospital B achieved the highest postintervention adherence rates (42.6%), along with the highest improvement. The improvements of hand hygiene adherence in physicians were higher in Hospitals B (8.4 percentage points) and D (8.3 percentage points) than they were in Hospitals A (4.1 percentage points) and C (4.0 percentage points).

Interventions performed at each hospital to improve hand hygiene adherence are summarized in Table 2 and the Appendix Figure. All hospitals performed feedback of hand hygiene adherence after the preintervention period. Interventions related to AHR were frequently initiated; self-carry AHR was provided in two hospitals (Hospitals C and D), and location of AHR was moved (Hospitals B and D). In addition, new AHR products that caused less skin irritation were introduced in Hospital B. Direct observation by hospital staff (separate from our study observers) was also done as part of Hospital A and D's improvement efforts. Other interventions included a 1-month campaign for hand hygiene including a contest for senryu (humorous 17-syllable poems; Table 2; Appendix Table), posters, seminars, and creation of a handbook related to hand hygiene. Posters emphasizing the importance of hand hygiene created by the local hospital infection control teams were put on the wall in several locations near wash basins. Seminars (1-hour lectures to emphasize the importance of hand hygiene) were provided to nurses. A 10-page hand hygiene handbook was created by one local infection control team and provided to nurses.

## DISCUSSION

Our study demonstrated that the overall rate of hand hygiene adherence improved from 22.4% to 33.6% after multimodal intervention; however, the adherence rates even after intervention were suboptimal. The results were comparable with those of a previous study in Japan,<sup>22</sup> which underscores how suboptimal HCW hand hygiene in Japan threatens patient safety. Hand hygiene among HCWs is one of the most important methods to prevent HAIs and to reduce spread of multidrug resistant organisms. High adherence has proven challenging because it requires behavior modification. We implemented WHO hand hygiene adherence strategies<sup>27</sup> and evaluated the efficacy of a multimodal intervention in hopes of finding the specific factors that could be related to behavior modification for HCWs.

We observed several important relationships between the intervention components and their improvement in hand hygiene adherence. Among the four participating hospitals, Hospital B was the most successful with improvement of hand hygiene adherence from 24.2% to 42.6%. One unique intervention for Hospital B was the introduction of new AHR products for the people who had felt uncomfortable with current products. Frequent hand washing or the use of certain AHR prod-



**FIG.** (A) Hand hygiene adherence rates in physicians and nurses before and after intervention (all hospitals); (B) Hand hygiene adherence among healthcare workers by hospital during pre- and postintervention periods.

ucts could irritate skin causing dry or rough hands, which could reduce hand hygiene practices. In Japan, there are several AHR products available. Among them, a few products contain skin moisturizing elements; these products are 10%-20% higher in cost than nonmoisturizing products. The HCWs in our study stated that the new products were more comfortable to use, and they requested to introduce them as daily use products. Thus, use of a product containing a hand moisturizer may reduce some factors negatively affecting hand hygiene practice and improve adherence rates.

Although this study was unable to determine which components are definitively associated with improving hand hygiene adherence, the findings suggest initiation of multiple intervention components simultaneously may provide more motivation for change than initiating only one or two components at a time. It is also possible that certain intervention components were more beneficial than others. Consistent with a previous study, improving hand hygiene adherence cannot be simply achieved by improving infrastructure (eg, introducing portable AHR) alone, but rather depends on altering the behavior of physicians and nurses.

This study was performed at four tertiary care hospitals in Niigata that are affiliated with Niigata University. They are located closely in the region, within 100 km, have quarterly conferences, and use a mutual monitoring system related to infection prevention. The members of infection control communicate regularly, which we thought would optimize improvements in hand hygiene adherence, compared with the circumstances of previous studies. In this setting, HCWs have similar education and share knowledge related to infection control, and the effects of interventions in each hospital were equally evaluated if similar interventions were implemented. In the current study, the interventions at each hospital were similar, and there was limited variety; therefore, specific, novel interventions that could affect hand hygiene adherence significantly were difficult to find.

There are a few possible reasons why hand hygiene adherence rates were low in the current study. First, part of this study

was conducted during the summer so that the consciousness and caution for hand hygiene might be lower, compared with that in winter. In general, HCWs become more cautious for hand hygiene practice when they take care of patients diagnosed with influenza or respiratory syncytial virus infection. Second, the infrastructure for hand hygiene practice in the hospitals in Japan is inadequate and not well designed. Because of safety reasons, a single dispenser of AHR is placed at the entrance of each room in general and not at each bedside. The number of private rooms is limited, and most of the rooms in wards have multiple beds per room, with no access to AHR within the room. In fact, the interventions at all four hospitals included a change in the location and/or access of AHR. Easier access to AHR is likely a key step to improving hand hygiene adherence rates. Finally, there was not an active intervention to include hospital or unit leaders. This is important given the involvement of leaders in hand hygiene practice significantly changed the hand adherence rates in a previous study.<sup>19</sup>

Given the suboptimal hand hygiene adherence rates in Japan noted in this and previous Japanese studies,<sup>21,22</sup> the spread of COVID-19 within the hospital setting is a concern. Transmission of COVID-19 by asymptomatic carriers has been suggested,<sup>11</sup> which emphasizes the importance of regular standard precautions with good hand hygiene practice to prevent further transmission.

Although the hand hygiene rate was suboptimal, we were able to achieve a few sustainable, structural modifications in the clinical environment after the intervention. These include adding AHR in new locations, changing the location of existing AHR to more appropriate locations, and introducing new products. These will remain in the clinical environment and will contribute to hand hygiene adherence in the future.

This study has several limitations. First, the presence of external observers in their clinical settings might have affected the behavior of HCWs.<sup>28</sup> Although they were not informed that their hand hygiene adherence was going to be monitored, the existence of an external observer in their clinical setting might have changed



normal behavior. Second, the infrastructure and interventions for hand hygiene adherence before the intervention were different in each hospital, so there is a possibility that hospitals with less infrastructure for hand hygiene adherence had more room for improvement with the interventions. Third, we included observations at different units at each hospital, which might affect the results of the study because of the inclusion of different medical settings and HCWs. Fourth, the number of physician hand hygiene observations was limited: We conducted our observations between 8 AM and 1 PM on weekdays because of observer availability, and many physicians visited their patients during other times of the day. Finally, we were unable to determine whether the improvements seen in each hospital were caused by specific intervention components. However, it is known that recognizing the importance of hand hygiene varies in different regions and countries in the world, and the goal for hand hygiene interventions is to establish a culture of hand hygiene practice.<sup>13</sup> Further evaluation is necessary to assess sustainability.

In conclusion, a multimodal intervention to improve hand hygiene adherence successfully improved HCWs' hand hygiene adherence in Niigata, Japan; however, the adherence rates are still relatively low compared with those reported from other countries. Further intervention is required to improve hand hygiene adherence.

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