



## ORIGINAL ARTICLE

# Patient, staff empowerment and hand hygiene bundle improved and sustained hand hygiene in hospital wards

Chia Yin Chong<sup>1b</sup>,<sup>1,2,3,4</sup> Marionette A Catahan,<sup>5</sup> Siok Hong Lim,<sup>6</sup> Thuraiya Jais,<sup>7</sup> Gian Kaur,<sup>8</sup> Shanqing Yin,<sup>9</sup> Dirk de Korne,<sup>10,11,12</sup> Koh Cheng Thoon<sup>1,2,3,4</sup> and Kee Chong Ng<sup>2,3,4,9</sup>

<sup>1</sup>Infectious Diseases, Paediatrics, <sup>5</sup>Quality Safety Risk management, <sup>6</sup>Infection Control, Division of Nursing, <sup>7</sup>Ward 55, Urgent Obstetric and Gynecology Centre, Division of Nursing, <sup>8</sup>Specialty and Ambulatory Services, <sup>9</sup>Chairman Medical Board Office, KK Women's and Children's Hospital, <sup>2</sup>Yong Loo Lin School of Medicine, National University of Singapore, <sup>3</sup>Paediatrics, Duke-NUS Medical School, <sup>4</sup>Lee Kong Chian School of Medicine, Nanyang Technological University, <sup>10</sup>Medical Innovation & Care Transformation, KK Women's & Children's Hospital, Singapore, <sup>11</sup>Department of Care and Welfare, SVRZ Cares in Zeeland, Middelburg and <sup>12</sup>Erasmus School of Health Policy & Management, Erasmus University Rotterdam, Rotterdam, Netherlands

**Aim:** We piloted a hand hygiene (HH) project in a ward, focusing on World Health Organization moments 1 and 4. Our aim was to design highly reliable interventions to achieve >90% compliance.

**Methods:** Baseline HH compliance was 57 and 67% for moments 1, 4, respectively, in 2015. After the pilot ward showed sustained improvement, we launched the 'HH bundle' throughout the hospital. This included: (i) appointment of HH champions; (ii) verbal/visual bedside reminders; (iii) patient empowerment; (iv) hand moisturisers; (v) tagging near-empty handrub (HR) bottles. Other hospital-wide initiatives included: (vi) Smartphone application for auditing; (vii) 'Speak up for Patient Safety' Campaign in 2017 for staff empowerment; (viii) making HH a key performance indicator.

**Results:** Overall HH compliance increased from a baseline median of 79.6–92.6% in end-2019. Moments 1 and 4 improved from 71 to 92.7% and from 77.6 to 93.2%, respectively. Combined HR and hand wash consumption increased from a baseline median of 82.6 ml/patient day (PD) to 109.2 mL/PD. Health-care-associated rotavirus infections decreased from a baseline median of 4.5 per 10 000 PDs to 1.5 per 10 000 PDs over time.

**Conclusions:** The 'HH Bundle' of appointing HH champions, active reminders and feedback, patient education and empowerment, availability of hand moisturisers, tagging near-empty hand rub bottles together with hospital-wide initiatives including financial incentives and the 'Speak Up for Patient Safety' campaign successfully improved the overall HH compliance to >90%. These interventions were highly reliable, sustained over 4 years and also reduced health-care-associated rotavirus infection rates.

**Key words:** bundle; compliance; hand hygiene; handrub consumption; intervention; patient empowerment.

## What is already known on this topic

- 1 Hand hygiene (HH) compliance is challenging to attain and sustain in hospitals.
- 2 Different hospitals have implemented different interventions to enforce HH compliance.

## What this paper adds

- 1 The HH bundle of appointing HH champions, active reminders and feedback, patient education and empowerment, availability of hand moisturisers, tagging near-empty handrub bottles was successful in sustaining HH compliance.
- 2 The 'Speak up for patient safety' campaign empowered staff to speak up and remind colleagues on HH, thereby helping to improve HH compliance.

Although hand hygiene (HH) is the most effective strategy to prevent health-care-associated infections (HAI), it is less than ideal in many countries despite World Health Organization's Multimodal Hand hygiene Improvement Strategy in 2009.<sup>1</sup> Most

hospitals reported a baseline 22–59% HH compliance while a review showed 40% median compliance (range 4–100%).<sup>2–7</sup> Moment 1 (before patient contact) compliance has been lower than moment 4 (after patient contact) (21 vs. 47%).<sup>5</sup> Our tertiary academic hospital, with a total of 830 beds, 13 000 deliveries per year and 32 000 paediatric admissions per year, showed comparable moment 1 compliance of 53.8% by observation.<sup>8</sup> In our pilot ward, the baseline compliance in 2015 was 57% and 67% for moments 1, 4 respectively. Our aim was to design highly reliable HH interventions and increase hospital-wide compliance to more than 90%.

**Correspondence:** Chia Yin Chong, KK Women's and Children's Hospital, 100 Bukit Timah Road, Singapore 229899. Fax: +65 6291 7923; email: chong.chia.yin@singhealth.com.sg

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## Methods

Our multidisciplinary project team comprised physicians, nurses and managers from various departments including infectious diseases, infection prevention, paediatrics, obstetric and gynaecology (O&G), environmental services, medical innovation and care transformation, as well as human factors. It was one of many other patient safety teams across different hospitals tasked to improve HAI and 'target zero harm'.

HH compliance was defined as performance of handrub (HR) or handwash divided by total number of observations. The Institute of Healthcare Improvement 'Ask 5 Take 5' survey method was used on a 32-bedded paediatric surgical ward as a pilot to understand the level of HH knowledge among 15 healthcare workers (HCW). Multiple plan-do-study-act (PDSA) cycles on proposed interventions, after exploring the root causes, were first conducted in the pilot ward.

### Phase 1: Initial pilot interventions

*PDSA 1* November 2015: An assigned HCW was to use an audible bell to remind HCW just before and after patient contact (Fig. 1a), along with nurses who accompanied doctors during ward rounds to offer hand rub.

*PDSA 2* February 2016: 'Black box' for HCW to 'drop' feedback on non-compliant HCW. HCWs gave negative feedback for this initiative, hence this was discontinued.

*PDSA 3* March 2016: Clips/ tags on almost-empty HR bottles to identify bottles that required replacements (Fig. 1b). Nurses accompany doctors for afternoon rounds to remind them about HH.

*PDSA 4* May 2016: Patients and care givers were encouraged to use a HH placard (Fig. 1c) to remind staff about HH Education. Eventually, the HH placard was later modified into permanent placards at the foot of patient's bed stating 'It's OK to ask if I have cleaned my hands' (Fig. 1d). Patients and care givers were educated on the importance of HH at patient admission using a new HH brochure (Fig. 1e).

### Phase 2: Spread in paediatric wards

*PDSA 5* November 2016: The 'HH Bundle' was developed and included: (i) appointment of HH champions in each inpatient ward; (ii) verbal/visual bedside reminders by colleagues; (iii) Patient education and empowerment: inclusion of HH orientation upon admission using brochures and empowering patients to remind HCW to perform HH; (iv) posters in the wards/bedside/computer terminals; (v) hand moisturisers; and (vi) tagging near-empty HR bottles for replacement.

Nursing and physician HH champions were appointed and their role was to remind colleagues to perform HH, to give active feedback: praise for good performance and correct non-compliance, and to be good role models. Nursing champions were also trained to audit moments 1, 4 and tasked to audit 30 opportunities per month across different staff designations. Our project team met with HH champions monthly to share each ward's data, personal stories and to suggest improvements. HH champions were rewarded with snacks/cakes at these meetings to 'celebrate the gains'.

Hand moisturisers were made available in the wards at nursing counters, doctors' offices and HCWs instructed when to moisturise hands: at the end of the shift and during tea/lunch breaks.

HH Posters were updated to incorporate new designs, including different patient images relevant for O&G and paediatrics. Posters were placed at ward entrances, lift doors and wobblers signage at computer terminals and above patient beds. Educational talks were given to HCW on HH including frequent mistakes and double moments. HRs were available at patient's bedside, computer terminals, treatment rooms, procedure trolleys, nursing counters, corridors and lift lobbies.

### Phase 3: Spread to O&G and more paediatric wards

When the interventions were sustained, we spread the HH bundle to more paediatric and O&G wards. During 2017, other hospital-wide initiatives were introduced: (i) use of a paid hand phone application (Semmel app, Petaling Jaya, Malaysia) for auditing; (ii) launch of the 'Speak up' for Patient Safety Campaign which enabled HCW to speak up to remind colleagues to practice HH; (iii) making HH a key performance indicator (KPI) for staff bonus. Prior to the Semmel app, audits were performed on hard copies and manually entered into excel spreadsheets. With the new application, auditors could use their smart phones to enter the results and the app would automatically calculate compliance rates.

Hospital administrators lent their support by incorporating HH compliance as a KPI. This was tracked according to hospital divisions and the salary bonus was allotted according to the division's performance by whether it met the threshold ( $\geq 70\%$ ), target ( $\geq 90\%$ ) or stretched ( $\geq 95\%$ ) HH compliance.

The 'Speak Up for Patient Safety' Campaign in 2017 encouraged all HCWs especially juniors to speak up to remind colleagues to perform HH. In return, HCWs were encouraged to thank colleagues for reminding them. HCWs who persistently demonstrated poor HH compliance despite timely reminders, were flagged up to higher management to 'have coffee/tea' with the IC Chairman for an informal educational chat on HH.

### Phase 4: More interventions in 2018

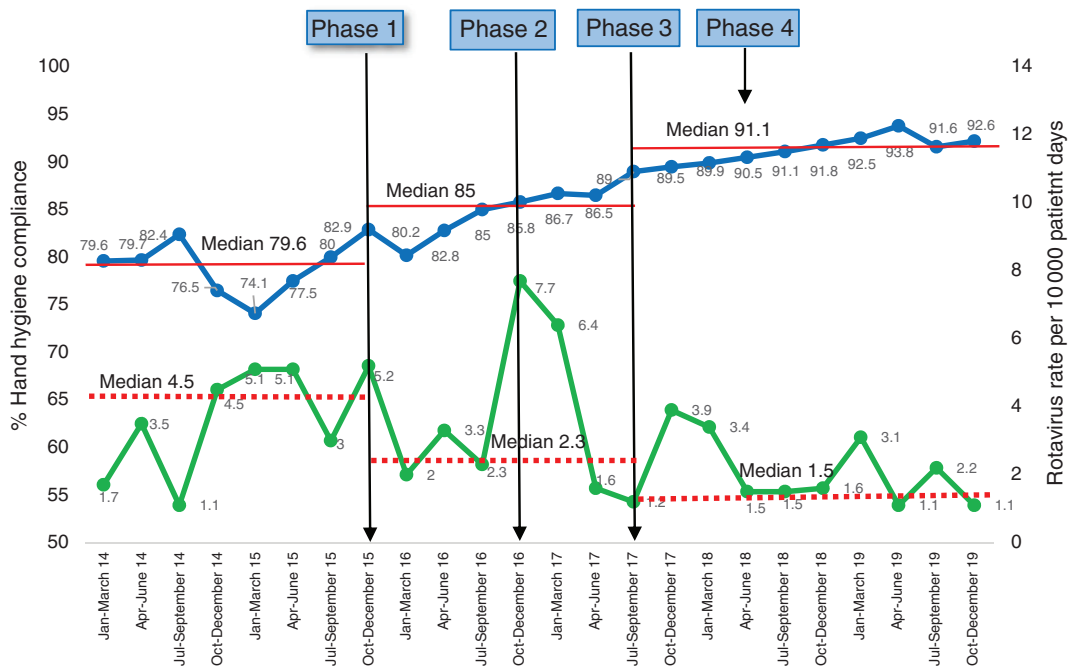
After the first four HH moments had shown improvement, moment 5 became the worst performing moment. A hospital-wide education on moment 5 was conducted and teaching slides were circulated to every unit in May 2018, including frequent mistakes, for example touching paediatric patients' phototherapy lights, infant basins and omitting HH. In the O&G delivery suite in June 2018, the project team went on-site to advise on the positioning of HR brackets based on the design of the delivery rooms and procedural workflow. In addition, corridors were also fitted with HRs so that doctors rushing to deliver babies could start performing HH en route to the delivery rooms. In November 2018, the original 70% alcohol 5% chlorhexidine HR (Microshield, Schulke, Norderstedt, Germany) was changed to a chlorhexidine-free alcohol-based HR (Softaman), with no change in the HW (Microshield). The purpose of the switch in HR was to reduce chlorhexidine-related hand dermatitis.



**Fig 1** Interventions in plan-do-study-act cycles 1, 3 and 4. (a) Reminder bell to remind staff. (b) Clip on tags. (c) Fan used by patient to remind staff to perform HH. (d) Signage at the foot of patient's bed. (e) Hand Hygiene brochure for Patient orientation.

Combined HR and hand wash (HW) consumption was calculated in mL per patient day (PD). This was derived by the volume of HR and HW used per ward and divided by total PD. This

consumption was chosen instead of HR or HW alone as surgical wards used more HW (due to the type of procedures performed in the ward), whereas medical wards used more HR.



**Fig 2** Overall hand hygiene (HH) and health-care-associated rotavirus infections. (—●—), HH compliance; (—●—), rotavirus rate per 10 000 patient days.

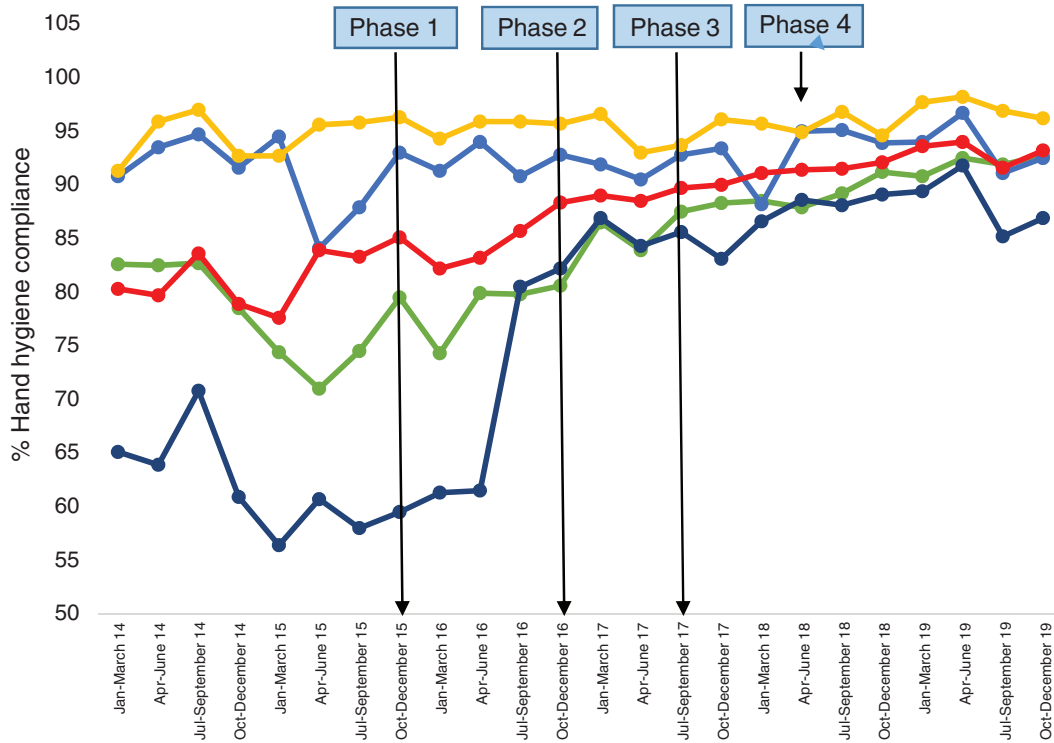


Fig 3 Hand hygiene compliance rates by moments. (—●—), moment 1; (—●—), moment 2; (—●—), moment 3; (—●—), moment 4; (—●—), moment 5.

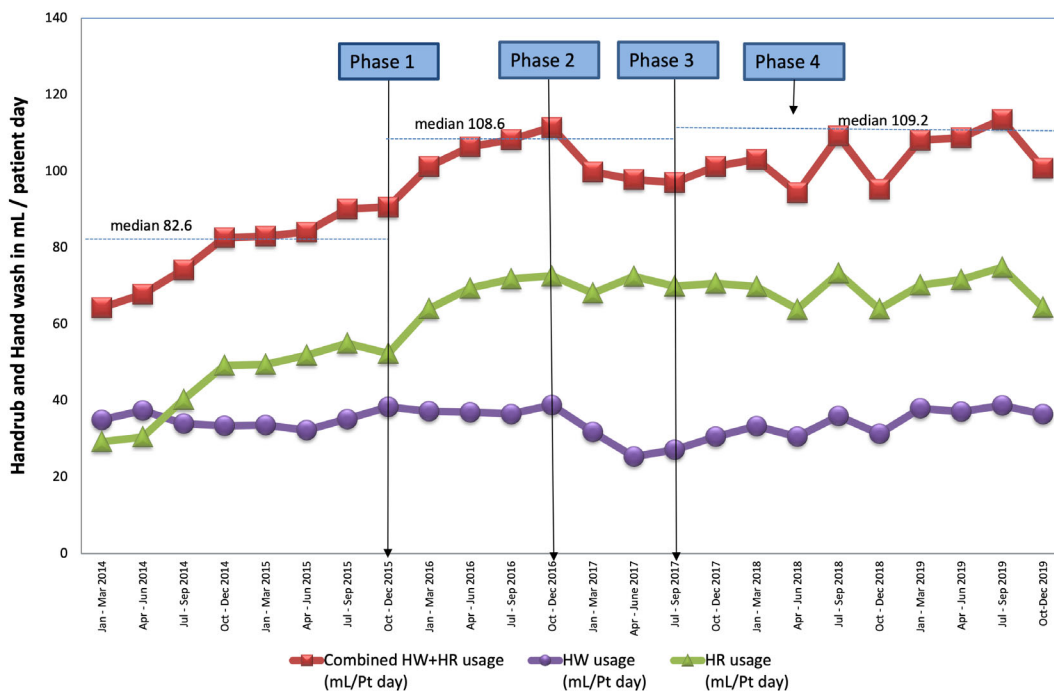


Fig 4 Hand rub and hand wash consumption. (—■—), Combined HW + HR usage (mL/Pt day); (—●—), HW usage (mL/Pt day); (—▲—), HR usage (mL/Pt day).

**Table 1** Incidence of multi-drug resistant organisms from 2015 to 2019

	2015, <i>n</i>	2016, <i>n</i>	2017, <i>n</i>	2018, <i>n</i>	2019, <i>n</i>
No. of patient days	240 052	240 440	240 709	245 389	212 580
No. of nosocomial MRSA bacteraemia	3	4	0	1	1
MRSA rate per 100 000 patient days	1.24	1.66	0	0.40	0.47
No. of nosocomial VRE cases	2	1	1	0	0
VRE rate per 100 000 patient days	0.83	0.42	0.41	0	0
No. of nosocomial					
CP-CRE	0	0	0	1	0
NDM	2	0	0	0	0
KPC	0	1	0	0	1
OXA	0	0	0	0	0
CP-CRE rate per 100 000 patient days	0.83	0.42	0	0.40	0.47

CP-CRE, carbapenemase-producing carbapenem-resistant Enterobacteriaceae; KPC, *Klebsiella pneumoniae* carbapenemase; MRSA, methicillin-resistant *Staphylococcus aureus*; NDM, New Delhi metallo-beta-lactamase; OXA, oxacillinase-producing Enterobacteriaceae; VRE, vancomycin-resistant enterococci.

Statistical analysis was performed using the SPSS version 19 (IBM, Armonk, NY, USA) and Open Epi statistical software programme. Student's *t*-test and rate ratios were used to compare continuous data, using  $P < 0.05$  as statistical significance. This quality improvement study was approved by the internal review board for waiver of consent.

## Results

The Ask 5 Take 5 survey showed that all HCW were aware of the five HH moments; 73.3% of HCW had no reason not to perform HH and would remind colleagues, 66.7% would perform HH if reminded by colleagues and 66.7% would either feel embarrassed or accept and perform HH if reminded by patients/care givers.

After PDSA 4, weekly HH compliance in the pilot ward improved from 57% to >80% for both moments 1 and 4. After the HH bundle was created, HH compliance improved in the four spread paediatric wards to an average of 86.9% in April–June 2017. Subsequently, we spread to more paediatric and O&G wards in July 2017. O&G wards' HH compliance showed an upward trend in compliance to 87.1–98.9% by end of 2018. The HH Bundle was further adapted for end-users and this included replacing the reminder bell by HCW's verbal proactive reminders to staff or by using hand signals whenever they witnessed near-miss opportunities.

Overall HH compliance increased from a baseline median of 79.6–85% (phase 1, 2) and 91.1% (phase 3) with a peak of 92.6% in the last quarter of 2019 (Fig. 2). Moment 1 compliance improved from a baseline of 71–82.2% (phase 2) and 92.7% (end 2019) (Fig. 3). Moment 4 compliance improved from baseline of 77.6–83.3% (phase 2) and 93.2% (end 2019).

Combined HR and HW consumption increased from baseline to 2019 as follows: phase 2 paediatric wards from  $77.1 \pm 42.6$  mL/PD to  $95.8 \pm 28.9$  mL/PD, phase 3 paediatric wards from  $83.1 \pm 36.3$  mL/PD to  $91.8 \pm 28.8$  mL/PD, O&G wards from  $54.6 \pm 14.0$  mL/PD to  $81.3 \pm 24.6$  mL/PD. The overall combined HR and HW consumption in all wards improved

from a baseline median of 82.6–108.3 mL/PD in phase 1, 2 to 109.2 mL/PD from phase 3 onwards (Fig. 4).

Health-care-associated rotavirus quarterly infection rates decreased from a baseline median of 4.5 per 10 000 PD to 2.3 per 10 000 PD in phase 1, 2 and then to 1.5 from phase 3 onwards (Fig. 2). Table 1 shows the Multi-drug resistant organism infection rates. Comparing 2017–2019 to 2015–2016, methicillin-resistant *Staphylococcus aureus* bacteraemia rates decreased by 80%, with a rate ratio of 0.2 (95% confidence interval, 0.03–0.88,  $P = 0.032$ ). Although vancomycin-resistant enterococci and carbapenemase-producing carbapenem-resistant Enterobacteriaceae rates decreased in 2017–2019, these were not statistically significant when compared with 2015–2016.

## Discussion

Our study showed that combining interventions into a HH bundle in addition to hospital-wide interventions led to sustained and reliable improvements in HH. In the pilot ward, patient empowerment was the game-changer intervention that led to the development of our HH bundle. Our HH bundle helped to spread HH compliance throughout the hospital. In addition, the 'Speak Up for Patient Safety' campaign in 2017 and inclusion of HH as a KPI helped to sustain the overall hospital HH compliance.

Single interventions alone cannot change HH compliance and patterns of behaviour.<sup>9,10</sup> In Geneva, a multi-pronged strategy was introduced comprising alcohol-based HR, education, poster campaigning, performance monitoring, feedback and support from hospital administration and clinicians.<sup>11</sup> Three randomised controlled trials showed that a HH bundle of education, reminders, feedback, administrative support and access to HRs resulted in improved HH compliance (pooled odds ratio 1.82; 95% confidence interval, 1.69–1.97).<sup>6–8</sup> Our HH bundle incorporated all of the above components but also included patient education and empowerment and widespread availability of hand moisturisers.

Patient empowerment was a major game-changer for HH compliance and was effective because HCW did not want to be reminded by patients/care givers as they considered this embarrassing. Our patient population is different from other general hospitals as it is a women's and children's hospital. Among the O&G wards, 56.4% are obstetric and 45% gynaecology patients. Among the paediatric admissions, majority (68.4%) are in <5 year age group (Data Analytics Office). Therefore, our average adult patient age is younger and the children have younger parents. This may have been one of the reasons for the successful patient empowerment campaign.

Patient empowerment is included as an integral part of the World Health Organization multimodal HH strategy and has been useful in many studies.<sup>12–14</sup> In our study, patients were routinely educated using the HH brochure upon admission and invited to remind HCWs to perform HH. McGuckin *et al.* reported 94% improvement in HH compliance when patients asked whether HCWs performed HH.<sup>12</sup> Despite patients' apparent willingness to participate, only 60–70% of patients actually asked their HCW about HH.<sup>12</sup> Longtin *et al.* found that 75% of patients were uncomfortable asking their nurse/physician to perform HH.<sup>14</sup> However, when HCWs invited patients to ask HCW about HH, 83 and 78% of patients felt comfortable asking nurses and physicians, respectively.<sup>14</sup> Our project used visual reminders placed at the foot of patient's beds to overcome patients' discomfort in reminding HCWs.

The improvement project benefited from the rollout of 'Speak Up for Safety' campaign during 2017, which empowered HCWs to remind senior HCWs on HH. After the bell reminder was discontinued, nurses devised a system of reminding HCWs by rubbing hands together as a signal or by offering HR to HCWs. This reminded HCWs to perform moments 1 and 4 when accompanied by nurses during ward rounds. Persistent non-compliance was fed back to the Chairman of infection prevention who had an informal chat with the HCW. This is similar to the bundle by Chou *et al.* which included violation letters and raised HH compliance from 34 to >90%.<sup>15</sup>

Our hospital administration made HH a KPI according to divisional units which was tied to the salary bonus. In addition, units with exemplary HH compliance were rewarded with food hampers at the annual Hand Hygiene Day in May. Other studies have also published on positive reinforcement rewards, including financial incentives.<sup>2,4,16</sup>

HR and HW consumption is an important surrogate marker for HH compliance. The 2011–2012 ECDC European Point Prevalence Survey reported HR median usage of 18.7 mL/PD across 1149 hospitals.<sup>17</sup> In another 232 hospitals, the median HR consumption was 21 mL/PD at the hospital level, 66 mL/PD in intensive care units (ICU), and 13 mL/PD in non-ICU units.<sup>18</sup> A consumption of slightly more than 100 mL/PD was postulated to be the requirement for 100% compliance.<sup>19</sup> Our median combined HR and HW consumption markedly improved from 82.6 mL/PD at baseline to 109.2 mL/PD in phase 3 onwards, therefore indicating a sustained improvement.

An incidental finding was the issue of hand dermatitis among HCWs. Chlorhexidine is frequently combined with alcohol in HRs due to its persistent activity on the skin.<sup>1,20–22</sup> However, it frequently causes irritant dermatitis in 10–45%, leading to diminishing HH compliance.<sup>23</sup> Our hospital switched to a

chlorhexidine-free HR to decrease hand dermatitis in November 2018. While we did not track dermatitis rates, the user acceptance rate for chlorhexidine-free HR was high.

One limitation of our study is that we did not survey patients as to whether they reminded HCWs. However, feedback on HH was included as part of the Hospital Consumer Assessment of Healthcare Providers and Systems survey from discharged patients, and the overall HH compliance as perceived by patients in end-2019 was about 86%. Another limitation is that we were unable to audit the seven steps of HH to check if HH was properly performed; instead, we chose to focus on HH opportunities instead. Due to the multiple interventions implemented over time, we were unable to determine which individual interventions contributed the most to the improvements.

## Conclusions

The 'HH Bundle' of appointing HH champions, active reminders and feedback, patient education and empowerment, availability of hand moisturisers, tagging near-empty hand rub bottles together with hospital-wide initiatives including financial incentives and the 'Speak Up for Patient Safety' campaign successfully improved the overall HH compliance to >90%. These interventions were highly reliable, sustained over 4 years and also reduced health-care-associated rotavirus infection rates.

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Fish by Yara Miran (7) from WOW Art Competition