


# BMJ Open Quality Spreading of hand hygiene change package across an acute hospital

Alvin Chew <sup>1</sup>, Seow Yen Tan,<sup>2</sup> Rajkumar Chandran,<sup>3</sup> Mui Mui Tang,<sup>4</sup> Vijo Poullose <sup>5</sup>, A Punithavathi,<sup>6</sup> Woo Boon Ang,<sup>1</sup> Augustine Tee<sup>7</sup>

**To cite:** Chew A, Tan SY, Chandran R, *et al.* Spreading of hand hygiene change package across an acute hospital. *BMJ Open Quality* 2025;14:e003220. doi:10.1136/bmjopen-2024-003220

Received 27 November 2024  
Accepted 16 March 2025



© Author(s) (or their employer(s)) 2025. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ Group.

<sup>1</sup>Office of Improvement Science, Changi General Hospital, Singapore

<sup>2</sup>Infectious Diseases, Changi General Hospital, Singapore

<sup>3</sup>Anaesthesia & Surgical Intensive Care, Changi General Hospital, Singapore

<sup>4</sup>Radiology Clinic, Changi General Hospital, Singapore

<sup>5</sup>Respiratory & Critical Care Medicine, Changi General Hospital, Singapore

<sup>6</sup>Nursing Administration, Changi General Hospital, Singapore

<sup>7</sup>Division of Medicine, Changi General Hospital, Singapore

## Correspondence to

Dr Alvin Chew;  
Alvin\_Chew@cgh.com.sg

## ABSTRACT

**Background** A set of interventions in a hand hygiene change package was developed in a pilot ward by the end of 2017. In 2018, Changi General Hospital embarked on scaling up the change package to other wards with the intention to eventually spread the hand hygiene change package hospital-wide.

**Methods** Changi General Hospital conducted a quality improvement project on hand hygiene with the intention to effect organisation-wide improvement in hand hygiene. Spread methodologies such as the Institute for Healthcare Improvement's framework for Spread and various complementary spread concepts such as having an organisational strategy, which plans for spread as early as possible, and addressing social aspects of change were applied in order to scale up and spread a change package.

**Setting** A general tertiary care hospital in Singapore.

**Results** Overall hospital-wide hand hygiene compliance improved from a median of 66% during the pilot phase to 73% in the scale-up phase ( $p < 0.05$ ) to 82% during the spread phase ( $p < 0.05$ ).

**Conclusions** A systematic approach to hand hygiene improvement based on spread literature successfully improved and sustained hospital-wide hand hygiene compliance. Success factors included the development of a change package that had clear guiding principles, with the intent to create proactive learning cycles within units which could be adapted to work in various contexts.

## INTRODUCTION

Literature suggested that hospital-acquired infections (HAIs) were a common issue worldwide, and between 5% and 10% of patients admitted to acute care hospitals acquired new infections.<sup>1</sup> HAI would result in patients having two and a half times longer length of stay, which resulted in almost three times higher hospital costs.<sup>2</sup> In addition to the impact on patients, literature also suggested that the financial burden of six common types of HAI was higher than the total financial burden of 32 major communicable diseases, which showed the implications of HAI on the wider healthcare system if left unaddressed.<sup>3</sup> Poor hand hygiene compliance had been shown to be contributing to patients acquiring HAI.<sup>3</sup>

In 2015, a pilot project was started to test out the value of a multifaceted set of hand

## WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Healthcare organisations worldwide have been introducing multimodal hand hygiene improvement strategies as recommended by WHO to improve hand hygiene compliance. The Institute for Healthcare Improvement Spread Framework likewise is a well-known framework for full-scale implementation of successful interventions from pilot sites. However, there is limited literature that explains how spread methodologies complement hand hygiene improvement strategies.

## WHAT THIS STUDY ADDS

⇒ This study explains the process of developing a hand hygiene change package that had clear guiding principles which could be adapted to work in various contexts and how spread methodologies were applied throughout the improvement journey.

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

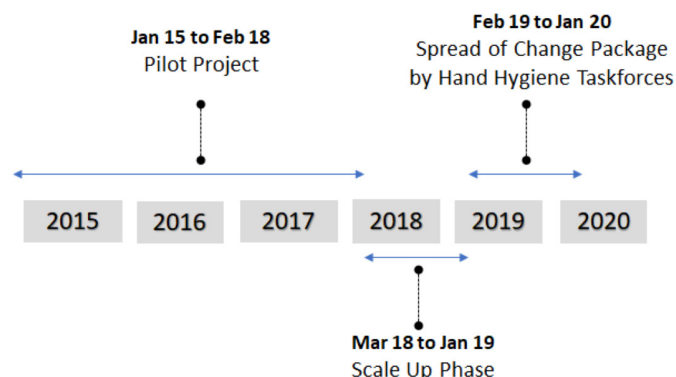
⇒ This study was built on established hand hygiene improvement strategies and literature on spread methodologies and would contribute to the body of knowledge in these subject areas. Illustrating how these theories or frameworks were operationalised and applied to the real-world context would help practitioners apply them in their own context.

hygiene interventions which was the recommended approach for hand hygiene improvement efforts.<sup>4</sup> At the start of the project, hospital-wide hand hygiene compliance was around 60%, which would be referenced as a baseline prior to improvement efforts.

The project successfully increased overall hand hygiene compliance in the pilot ward by 20%–30% from baseline in 3 years.

The interventions could largely be divided into three phases. Details of the interventions tested could be found in the paper published by Poullose in 2022.<sup>5</sup>

Phase 1 was focused mainly on Education and an Audit-feedback process. Phase 2 relied on incentives and social pressure, with the interventions mainly focused on positive reinforcement and culture building. Based on the learnings from the earlier phases, the project



**Figure 1** Timeline of the project.

then moved on to phase 3, which was driven by a hand hygiene change package that was successfully tested out in the pilot ward.

In this paper, the findings of efforts to scale up and spread the hand hygiene change package from March 2018 onwards would be shared. The timeline for the project could be found in the figure below (figure 1).

## METHODS

### Setting

Changi General Hospital is a tertiary care government restructured hospital with over 1000 beds serving the eastern population of Singapore.

### Project design

When the hand hygiene project first commenced in 2015, the intention was to eventually spread the interventions hospital-wide. The Model for Improvement<sup>6</sup> was the foundational methodology that underpinned the improvement efforts throughout the project. Literature from the WHO on guidelines on hand hygiene in healthcare<sup>7</sup> and implementation of the WHO multimodal hand hygiene improvement strategy<sup>8</sup> also guided the organisational improvement efforts.

The organisation referenced the Institute for Healthcare Improvement (IHI) Spread Framework.<sup>6</sup> The framework consists of the following components for spread: the responsibilities of leadership, identification of better ideas, communication, strengthening the social system, measurement and feedback and knowledge management.

For the component of responsibilities of leadership, the senior management played a key role in identifying hand hygiene as a key strategic initiative and deciding that the target population would be all professional groups active in the wards. There was also careful planning of the set-up for spread from the very outset, with the senior management identifying early adopters, a suitable pilot site, assigning of executive sponsors to provide resources and setting up of a multidisciplinary team. The pilot team comprised a doctor and a nurse manager as team leaders for this project. Members of the team included ward nurses, physiotherapists, a radiographer, an infection prevention and control nurse and facilitators

from the quality improvement (QI) department. The pilot team also engaged representatives from the hospital porters and housekeeping staff as ad-hoc members of the team. The pilot team was meant to be representative of the professional groups that the change would eventually impact.

For the component of identification of better ideas, a medical ward with 44 beds was selected as the pilot site as the unit leaders were known to be supportive of hand hygiene-related initiatives. The idea was that interventions that worked well in a dynamic environment such as a medical ward would likely be more easily adapted into more controlled environments or have their principles applied to other dynamic settings. Robust testing was done during the pilot project to continually look for better ideas. Ideas that worked well were refined, while ideas that were unsuccessful were discontinued. The project team then identified the ideas that should be included in the change package. There were also infrastructural improvements during the pilot phase, such as the change to a new alcohol hand rub product that had moisturising ingredients and the repositioning of automatic alcohol hand rub dispensers to be near personal protective equipment.

For the component of strengthening the social system, when the pilot project was completed after 3 years and developed a change package, the senior leadership continued to play a key role in reaffirming scale-up and spread plans and creating the social system by securing the commitment of departmental heads and getting the right staff on board to support scale-up and spread efforts. When the scale-up efforts were completed and the change package robustly tested, a spread team was established to spread the interventions to the rest of the applicable care settings. The organisation felt that it was necessary to create a new spread team as the pilot team had already done an extensive amount of work over 3 years to come up with the change package and that the burden to drive the spread efforts should not be placed on the same group of staff. Therefore, a new spread team was set up to drive spread efforts with key members of the pilot team playing an advisory role instead. Outpatient areas and the emergency department were excluded from the spread efforts due to their unique set-up requiring a different set of improvement strategies.

For the component on communication, the spread team worked out communication strategies such as holding engagement sessions with departmental heads and ward leaders at the start of the spread phase. Before implementation, briefings were also done at communication platforms of various professional groups to inform of the change ideas and how they would impact the ground.

For the component of measurement and feedback, the project team regularly reported hand hygiene rates to senior leadership, received feedback on matters such as the strategic direction and garnered support in matters such as approval of key initiatives, securing resources and removal of obstacles. Regular updates by the spread team

### Box 1 Hand hygiene change package

- ⇒ Training on audit standards and feedback technique—phase 1: preparation phase
- ⇒ Direct feedback template and hand hygiene dashboard (figures 5 and 6)—phase 2: identification and feedback phase
- ⇒ Suggested process to address weak areas identified by the dashboard—phase 3: closing of gaps phase
- ⇒ Hand hygiene educational materials—phase 3: closing of gaps phase
- ⇒ Discussion about hand hygiene in unit or team communication platforms (eg, safety huddles and roll call)—phase 4: building culture and strengthen system phase

and respective department hand hygiene representatives on hand hygiene rates and change ideas at various platforms also acted as a form of accountability and contributed to the sustenance of hand hygiene rates.

For the component of knowledge management, department champions who were part of the spread team were consulted and helped explain the thinking behind the change ideas and adaptations relevant to the respective profession groups. Day-to-day managers were also invited to share their experience with department representatives at spread team meetings.

### INTERVENTIONS

Various hand hygiene initiatives were tested out in the pilot site, and the pilot team eventually came up with a hand hygiene change package that was based on the concept of creating a proactive learning cycle to improve hand hygiene practices within a unit. Units could refer to wards, clinical teams or departments.

The concept consisted of four phases which happened sequentially as the earlier phase would lay the foundation for the later phases to build on.

The first phase, the preparation phase's focus was on enabling the unit leader, for example, nurse managers for wards, senior physicians for inpatient medical teams, etc. Unit leaders were equipped with knowledge of audit standards and feedback techniques so that they were able to contextualise hand hygiene principles for the interpretation of unique situations and routine activities.

The second phase, the identification and feedback phase, involved unit leaders providing direct feedback to staff during their routine presence in unit operations and collecting information in a visual template that could be translated into a dashboard. Infection prevention and control nurses would likewise provide direct feedback to staff during their routine hand hygiene audits. This copartnership of unit leaders and auditors helped coach staff on the ground while driving a consistent message to the staff on the importance of hand hygiene.

The third phase, the closing of gaps phase, involved active mitigation by unit leaders where they identified and mitigated situations that led to an increase in the likelihood of non-compliance. This was aided by creating a system

that gave data for local improvement to the unit leaders by requiring them to provide direct feedback and capturing the information in a visual template and dashboard. The direct feedback template was designed to be in grayscale in order for unit leaders to indicate their observations in a visual template that allows them to quickly pinpoint weak areas. Having much direct feedback given at certain time periods, activities or specific moments of hand hygiene would clearly point out that the interventions would need to be targeted at those areas. Templates used by different unit leaders would then be collated and the data reflected in a dashboard for the unit. The different colour stickers used in the dashboard would help differentiate the weak areas for different professional groups so that interventions can be customised for each group.

The fourth phase, the building culture and strengthen system phase, involved initiatives driven by unit leaders that targeted the less tangible aspects of change. These initiatives included unit leaders customising initiatives that targeted the collective knowledge of staff, the awareness of the five moments of hand hygiene and understanding the importance of hand hygiene. System-based initiatives that ensured sustainability in the unit included leaders incorporating hand hygiene content into the orientation of new staff, how one-to-one and group-based communication was done in the unit and acting on hand hygiene indicators. Positive reinforcement, which was a concept explored during the pilot phase, was also used to motivate staff and contributed towards culture building. This phase could also happen concurrently with the first phase but with the existing setup improved on from the learnings from earlier phases.

Using these concepts as key guiding principles, the team reviewed the many interventions tested out in the pilot ward and identified those that would be critical to operationalise these concepts to create a hand hygiene change package (box 1). Each component of the change package would target the different phases.

Following the development of the change package, the team prepared for the scale-up phase by reaffirming the scale-up plans with the senior management and identifying three other wards for robust testing of the change package. As the pilot ward was a medical ward, one other medical ward and two surgical wards were identified as scale-up test sites to attempt to replicate the impact in a similar setting and to adapt changes in a different setting. Concurrently, there were efforts that made the change package work for the doctors, allied health and ancillary staff.

During the scale-up phase, the team clearly identified which were the core components of the change and which were the non-core components that could be tolerant to adaptation by the adoption units. Core components included equipping unit leaders and direct feedback driven by unit leaders. Therefore, training unit leaders, giving direct feedback and the use of the direct feedback template to record findings were established to be non-negotiable aspects of the change.

**Table 1** Adaptation of the change package

	<b>Nurses (medical wards)</b>	<b>Nurses (surgical wards)</b>	<b>Doctors</b>	<b>Allied health/ancillary staff</b>
Key challenges	Adjusting to the new practice of coaching staff in hand hygiene	Hesitancy in giving direct feedback to other professions	Team-based rather than ward-based with regular rotation resulting in the need to engage leaders of ward round teams to maintain ownership in ensuring good practice in their teams.	Staff were assigned to specific wards/units with regular rotation. Due to the operational structure, the importance placed by the department on driving good hand hygiene practice would be critical.
Strategies	Pilot ward shared experience	Engagement of leaders for buy-in	Ownership through consultant-led coaching audit	Departmental-level engagement through champions
Adaptation	Representatives from the pilot team communicated to their respective professional groups	More time spent to prepare the ground Easing in by starting with direct feedback to the same professional group	Consultants audited and coached juniors Team-based initiatives to close gaps	Monthly departmental-level sharing of results and education Coaching by supervisors

Non-core components included how the leaders carried out their mitigation strategies and initiatives. Therefore, the suggested process to address weak areas and hand hygiene educational materials were provided only as a reference to the unit leaders for carrying out mitigation strategies. It was also left to the unit for identifying the right platform for communication about hand hygiene practices and initiatives.

When the three scale-up test sites showed that they sustained high levels of hand hygiene compliance, senior management played a role in setting up a Surgical Hand Hygiene Taskforce and Medical Hand Hygiene Taskforce, as they were convinced that both disciplines had a unique set of challenges, and efforts should be led by staff from the respective disciplines. The leaders from the pilot team were asked to help with spread efforts on an advisory basis while new leaders were appointed to drive spread efforts. Efforts of both taskforces were coordinated by a core group of clinician leads, an infection prevention and control nurse, QI facilitators and advisors from the pilot project. Members were doctors, nursing and allied health staff who were appointed as hand hygiene champions of their department. Training of unit leaders commenced from January 2019, and by April 2019, the change package was rolled out to all units and profession groups (table 1).

Having established the core components and non-core components of the change package and understanding the challenges faced by the different groups that the change package would be applicable to, varied strategies and adaptations were made for the change package to work in the context of the various groups. The following table summarises the challenges faced, strategies employed, and adaptations made while retaining the key principles of having unit leaders who owned the problem,

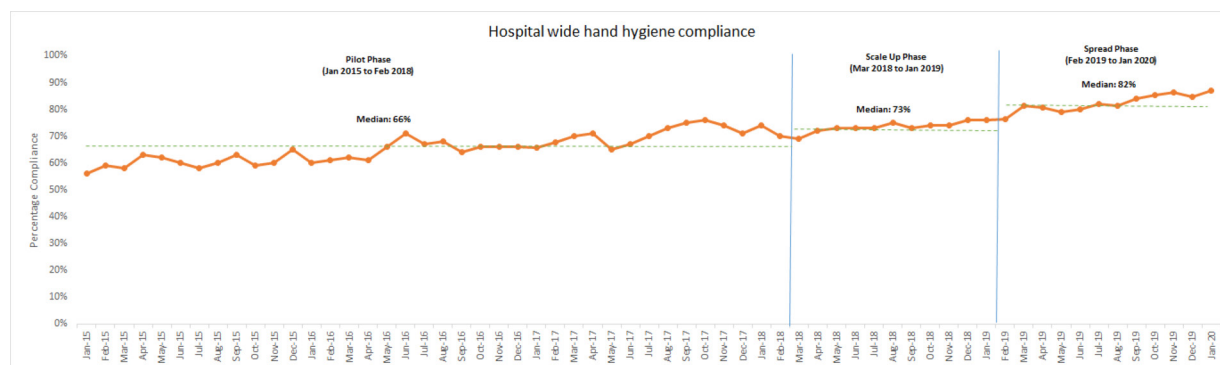
gained awareness of the gaps and drove change by initiating interventions (table 1).

## RESULTS

Hospital-wide hand hygiene compliance improved from a baseline of 60% to 66% in the pilot phase to 73% in the scale-up phase and 82% in the spread phase over a period of 5 years (figure 2). A two-sample t-test was used to determine the statistical significance of the results from the pilot phase (66%) to the scale-up (73%) phase, and the improvement was statistically significant ( $p<0.05$ ). A two-sample t-test was also used to determine the statistical significance of the results from the scale-up phase (73%) to the spread phase (82%), and the improvement was similarly statistically significant ( $p<0.05$ ).

Hospital-wide compliance to the change package, which was the process measure, also increased from a median of 50% to 97% from July 2019 onwards (figure 3). This improvement was attributed to the taskforces having an overview of the compliance rates to the change package for each unit and sharing it during meetings from July 2019 onwards. This helped the taskforces to identify and work more closely with the units that were facing issues adapting to the change package.

Hospital-wide Methicillin-resistant *Staphylococcus aureus* (MRSA) acquisition rate decreased from 7% in 2015 to 2% by 2019 (figure 4), and the results were congruent with findings from the literature that hand hygiene compliance had a negative correlation with healthcare-acquired infections (table 2), including a decrease in serious infections.<sup>9 10</sup>



**Figure 2** Run chart of hospital-wide hand hygiene compliance rates.

## DISCUSSION

Our study would contribute to the body of knowledge in the improvement science domain of spread literature, and the findings of our work reaffirmed concepts such as having an organisational strategy which plans for spread as early as possible, having senior leadership involvement, navigating the system factors and addressing social aspects of change.

Hospital-wide hand hygiene rates, being a strategic indicator, were monitored. It was expected right from the beginning that successful interventions from the pilot site needed to be scaled up and spread to applicable sites hospital-wide. Therefore, considerations about scaling up and spreading were factored in as early as possible.

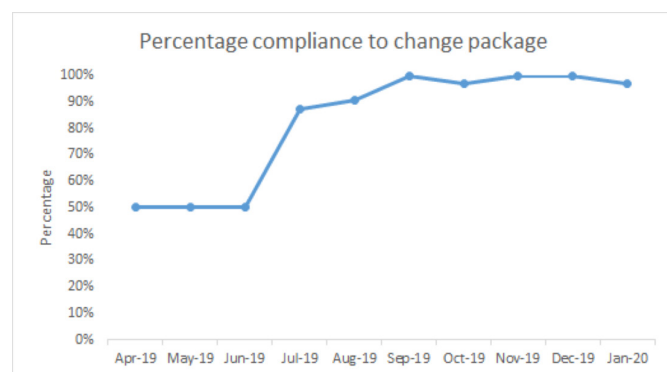
Barker introduced the term, ‘scalable unit’ as the smallest representative facsimile of the system targeted for full-scale implementation.<sup>11</sup> Improvement efforts done with the initial pilot team and the pilot site helped the team understand the representative subsystem that generated a set of context-sensitive change packages that could be refined at a broader range of settings. Therefore, during the development of the hand hygiene change package, the team started coming up with concepts of how the change package was intended to work. Based on the guiding principles from the concepts, the team had to deliberate between which were the core components and non-core components of the change package and how they could be applied in the context of a representative subsystem. Horton explained that complex interventions

were context-sensitive and tolerance to alteration would be key to making interventions work.<sup>12</sup> In behavioural science, the ‘IKEA effect’ suggested that people valued self-made products more highly than identical, externally assembled versions, thus allowing for adaptation would be critical to enable interventions to be adopted.<sup>13</sup> Grol suggested that several different theories from different disciplinary perspectives such as cognitive theories and behavioural theories provided insights into why non-compliance happened and offered potential solutions.<sup>14</sup> Therefore, the change package would also have to be well thought out to be addressing these factors at a system level.

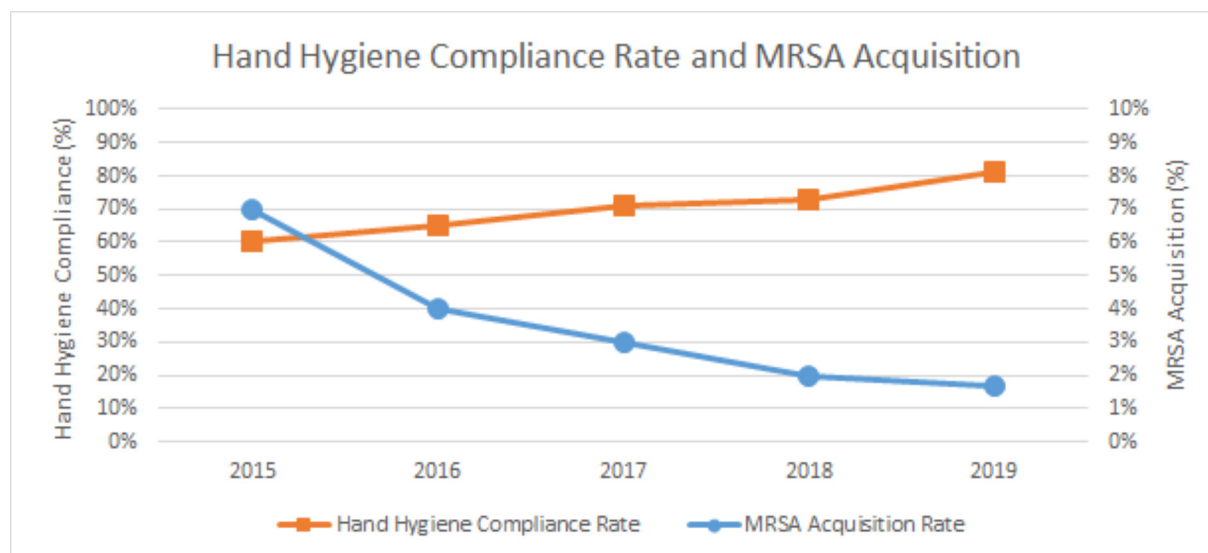
The selection of three wards for the scale-up phase was based on the applicable care setting. Likewise, when setting up the two taskforces for spread, members of the taskforces were also carefully selected to mirror the stakeholders of the representative subsystem.

The National Health System Scotland defined spread to be, ‘when best practice was disseminated consistently and reliably across a whole system and involved the implementation of proven interventions in each applicable care setting’.<sup>15</sup> Therefore, the scale-up phase took about 10 months from adapting interventions from the beginning to ensuring that improved hand hygiene rates could be sustained for at least a 6-month period (achieved results that were statistically significant according to run chart rules)<sup>6</sup> before moving on to the spread phase. The scale-up phase was thus important to ensure that interventions were proven to be robust enough to be spread.

Dixon-Woods stressed the importance of social components in spread efforts.<sup>16</sup> Therefore, besides the technical aspects of the change package, the team put in extensive efforts in seeking buy-in from the departmental heads, appointing champions as members of the taskforces to get them to help in communicating about the initiative and empowering unit leaders to own the problem. For direct feedback to work at a system level, the culture where staff could remind each other regardless of profession and rank had to be inculcated through messaging at the organisational leadership level and role modelling at the unit leader level. Literature suggested that any attempt to influence key culture dimensions needed to be part of a much wider assemblage of mutually reinforcing



**Figure 3** Run chart of hospital-wide percentage compliance to change package.



**Figure 4** Run chart of hospital-wide hand hygiene compliance rate and hospital-wide MRSA acquisition.

improvement activities.<sup>17</sup> Therefore, the social components of spread, which included the buy-in from leaders and champions, were critical for the success of the interventions. These social components of change complemented the giving of direct feedback driven by unit leaders.

The IHI White Paper on ‘A Framework for Spread’ also advocated having a measurement and feedback system in place for the spread phase.<sup>18</sup> The key measurements were the hospital-wide hand hygiene compliance rates and compliance to the change package. Hand hygiene rates of the individual departments within the surgical and medical disciplines, respectively, were also shared during regular meetings by the taskforces. This allowed the champions within the taskforces to have an idea of how their department’s hand hygiene rates compared with other departments. The better-performing departments were asked to share about their initiatives to promote learning, while the departments with poorer compliance were asked about their challenges and to consider interventions that worked well in other departments. This allowed for organic cross-pollination of ideas across departments through the taskforce platform. During the initial months of spread, compliance rates to the change package were low. The monitoring of compliance rates allowed the taskforces to find out the challenges faced by certain departments and work with them to resolve issues

which helped to improve compliance with the change package from July 2019 onwards.

There were various obstacles faced during the spread of the change package. During the initial stages, the surgical discipline faced greater challenges in getting buy-in from the leaders as there were greater levels of resistance towards the changes, especially in getting used to receiving direct feedback from staff from other professional groups. The 3-year pilot project helped gather a good level of buy-in from the medical discipline as professional groups were exposed to the changes in the pilot ward. On the other hand, the changes were relatively new to the surgical discipline, and exposure by staff was limited to the short period of less than a year during the scale-up phase. Considerable efforts were taken by the surgical taskforce to present the changes on various platforms. Surgical ward nurses were also more hesitant in giving direct feedback. A paper by Gardezi suggested that in the surgical discipline, especially in the operating room, nurses often feel constrained in what they are able to say or feel that they are a passive audience to others.<sup>19</sup> The surgical taskforce set up an engagement session where surgical department heads engaged with the surgical ward leaders to assure them of the support. A significant number of unit leaders also had to be equipped during the early stages. This took quite a few training sessions held over a few months. Unit leaders also needed to be

**Table 2** Comparison of hand hygiene compliance rates at various phases

Pilot phase median (January 2015 to February 2018)	Scale-up phase median (March 2018 to January 2019)	Difference in median between the pilot and scale-up phase	P value of the difference in median between the pilot and scale-up phase (two-sample t-test)	Spread phase median (February 2019 to January 2020)	Difference in median between the scale-up and spread phase	P value of the difference in median between the scale-up and spread phase (two-sample t-test)
66%	73%	7%	0.00	82%	9%	0.00

Names of staff (Fill in below)						Date:		Name of Unit Leader:	
1)	2)	3)	4)	5)	6)	7)	8)	9)	10)
11)	12)	13)	14)	15)	16)	17)	18)	19)	20)

### Timings

**AM** 7am 8am 9am 10am 11am 12am 1pm 2pm

**PM** 3pm 4pm 5pm 6pm 7pm 8pm 9pm

**ND** 10pm 11pm 12pm 1am 2am 3am 4am 5am 6am

### Profession

DOCTORS

NURSES

ALLIED HEALTH

ANCILLARY

### Clinical Task

Medication Administration

Vital sign taking

Intravenous drip or cannula

PPE

Hypocount

Taking blood

Turning patient

Sponging

Ward Rounds

Therapy

General task

### 5 Moments of Hand Hygiene

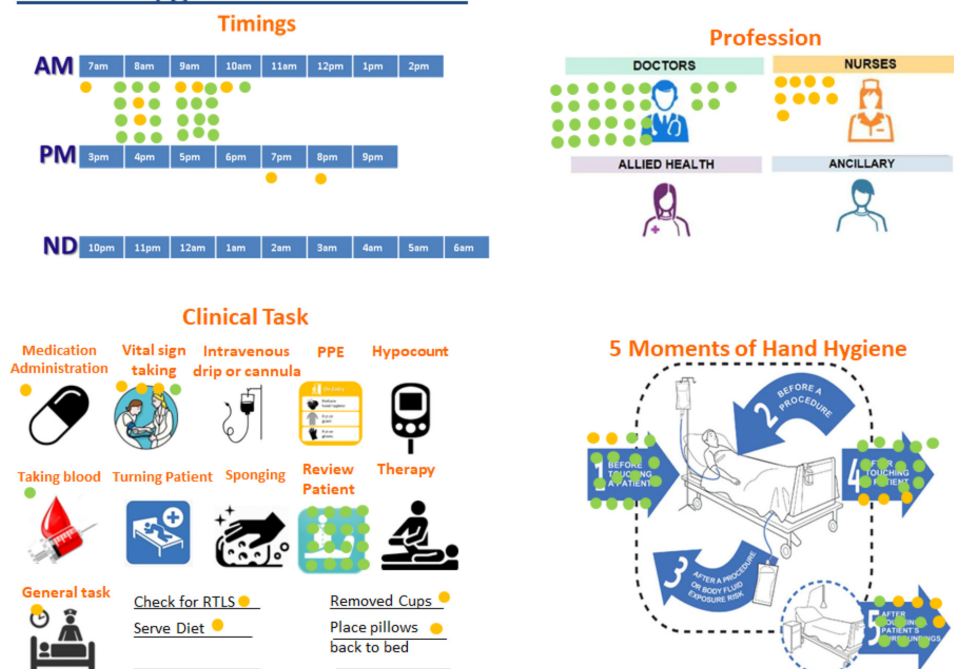
**Figure 5** Direct feedback template. \*Personal Protective Equipment (PPE).

convinced to take up a more active role in driving hand hygiene efforts in their respective units. Therefore, senior leaders had to engage the unit leaders and stressed the importance of the initiative. These challenges were eventually overcome, which led to significant improvement in hospital-wide hand hygiene compliance rates.

Due to the long study span of 5 years from 2015 to 2019, study limitations included being unable to establish the

effect of factors external to the study such as external audits, benchmarking and scorecard indicator pressure on hospital-wide hand hygiene rates. The impact of the educational interventions was also not formally evaluated for this publication. Other study limitations include not having formal measurements for balancing indicators such as the number of skin complaints. From the 3-year pilot study efforts, skin complaints were not deemed to

## Hand Hygiene Dashboard



**Figure 6** Hand hygiene dashboard.

have high enough frequency to require a formal measurement, and interventions targeted at skin issues, such as having sufficient moisturisers and a change to a more moisturising hand hygiene product were also in place. The organisation's concurrent safety culture efforts in promoting a speaking up culture may also have contributed to interventions such as the giving of direct feedback being more well received by the ground staff. The scope of this study also excluded the COVID-19 period when there were many external factors influencing hand hygiene rates during that period. At the point of publishing, hand hygiene compliance rates had been sustaining at higher rates than the rates achieved during the spread phase, ranging from 87% to 90% in the last 6 months of 2024.

## CONCLUSIONS

The work by the pilot team and the two taskforces over a period of 5 years led to the development and spread of a change package to bring about improvement in hand hygiene. There had been a significant improvement in the hospital-wide hand hygiene compliance rate, which improved from a median of 66% during the pilot phase to 73% in the scale-up phase and was sustained at 82% during the spread phase by the end of 2019.

The work done during the hand hygiene improvement journey in the inpatient areas had built a strong foundation for future hand hygiene improvement efforts in other areas of the hospital.

A change package for hand hygiene was successfully spread hospital-wide with success factors that included the development of a change package that had clear guiding principles with the intent to create proactive learning cycles within units which could be adapted to work in various contexts.

**Contributors** All authors listed in this manuscript contributed to the design and implementation of this quality improvement initiative. As a multidisciplinary team, each author made unique contributions, providing understanding in their area of work and shedding insights that may not be known to other team members. SYT and RC provided their invaluable leadership to the initiative, driving the spread efforts as leaders of the Spread Team. VP and AP contributed their understanding of the pilot project and served as advisors to the Spread Team. MMT contributed subject matter expertise in infection prevention and control, which included hand hygiene and trained unit leaders in application knowledge of hand hygiene. WBA and AC facilitated the project and guided the team to test changes systematically using spread methodologies as quality improvement specialists. AT as project sponsor supported initiatives and helped gather buy-in from department heads. The main author is the guarantor for this publication.

**Funding** The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

**Competing interests** None declared.

**Patient and public involvement** Patients and/or the public were not involved in the design, conduct, reporting or dissemination plans of this research.

**Patient consent for publication** Not applicable.

**Ethics approval** The SingHealth Centralised Institutional Review Board (CIRB) reviewed and determined that the application (CIRB Ref: 2023/2504) does not require further ethical deliberation because this application is an evaluation of the hand hygiene change package.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data availability statement** All data relevant to the study are included in the article or uploaded as supplementary information.

**Open access** This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

## ORCID iDs

Alvin Chew <http://orcid.org/0000-0003-1604-6671>

Vijo Poulouse <http://orcid.org/0000-0002-6069-5700>

## REFERENCES

- Burke JP. Infection control - a problem for patient safety. *N Engl J Med* 2003;348:651–6.
- Plowman R, Graves N, Griffin MA, *et al*. The rate and cost of hospital-acquired infections occurring in patients admitted to selected specialties of a district general hospital in England and the national burden imposed. *J Hosp Infect* 2001;47:198–209.
- Peters A, Schmid MN, Parneix P, *et al*. Impact of environmental hygiene interventions on healthcare-associated infections and patient colonization: a systematic review. *Antimicrob Resist Infect Control* 2022;11:38.
- Boyce JM, Pittet D, Healthcare Infection Control Practices Advisory Committee, *et al*. Guideline for Hand Hygiene in Health-Care Settings. Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HIPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. *Am J Infect Control* 2002;30:S1–46.
- Poulouse V, Punithavathi A, Ali M, *et al*. Improving hand hygiene in a medical ward: a multifaceted approach. *BMJ Open Qual* 2022;11:e001659.
- Langley MR, Nolan KM. *The improvement guide: a practical approach to enhancing organizational performance*. 2nd edn. Jossey-Bass, 2009.
- WHO. WHO guidelines on hand hygiene in health care. 2009.
- WHO. A guide to the implementation of the who multimodal hand hygiene improvement strategy. 2009.
- Mouajou V, Adams K, DeLisle G, *et al*. Hand hygiene compliance in the prevention of hospital-acquired infections: a systematic review. *J Hosp Infect* 2022;119:33–48.
- Yeung WK, Tam WSW, Wong TW, *et al*. Clustered randomized controlled trial of a hand hygiene intervention involving pocket-sized containers of alcohol-based hand rub for the control of infections in long-term care facilities. *Infect Control Hosp Epidemiol* 2011;32:67–76.
- Barker PM, Reid A, Schall MW. A framework for scaling up health interventions: lessons from large-scale improvement initiatives in Africa. *Implement Sci* 2016;11:12.
- Horton TJ, Illingworth JH, Warburton WHP. Overcoming Challenges In Codifying And Replicating Complex Health Care Interventions. *Health Aff (Millwood)* 2018;37:191–7.
- Norton MI, Mochon D, Ariely D. The IKEA effect: When labor leads to love. *J Consum Psychol* 2012;22:453–60.
- Grol R, Grimshaw J. From best evidence to best practice: effective implementation of change in patients' care. *Lancet* 2003;362:1225–30.
- Daniel M, Glassborow R, Renfrew M, *et al*. The spread and sustainability of quality improvement in healthcare. NHS Scotland Quality Improvement Hub; 2014.
- Dixon-Woods M, Bosk CL, Aveling EL, *et al*. Explaining Michigan: developing an ex post theory of a quality improvement program. *Milbank Q* 2011;89:167–205.
- Davies HTO, Nutley SM, Mannion R. Organisational culture and quality of health care. *Qual Health Care* 2000;9:111–9.
- Massoud MR, Nielsen GA, Nolan K, *et al*. A framework for spread: from local improvements to system-wide change. IHI Innovation Series white paper. Cambridge, Massachusetts: Institute for Healthcare Improvement, 2006.
- Gardezi F, Lingard L, Espin S, *et al*. Silence, power and communication in the operating room. *J Adv Nurs* 2009;65:1390–9.