

A DMAIC approach to improve hand hygiene compliance rate

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Abstract

Good hand hygiene is a critical factor in preventing infection and providing high quality care. This project was originated in two Intensive Care Units (ICU) with goal to improve hand hygiene compliance rate. An electronic monitoring system was installed and used to monitor the rate during the project. After measurement of the baseline and adjustment of the rate, the target was defined. An education campaign for the nursing staff was designed and run for 3 weeks, after which compliance rate was re-measured. The compliance rate successfully reached the goal, showing that education had a significant effect on hand hygiene compliance.

Keywords

Hand Hygiene, compliance rate, education, electronic monitoring,

1. Introduction - Literature Review

HealthCare-associated infections (HCAIs) are “infections patients can get while receiving medical treatment in a healthcare facility”, as defined by the Center for Disease Control and Prevention (CDC) [1]. The World Health Organization (WHO) estimates the number of deaths due to HCAIs to be as high as 99,000 in 2002, with associated cost summing up to \$6.5 billion in 2004. [2]

“Reduce the risk of health care–associated infections” is one of the National Patient Safety Goals designated by the Joint Commission. For hand hygiene specifically, the Joint Commission requires that healthcare organizations comply with the guidelines established by the Center for Diseases Control and prevention (CDC) and / or the World Health Organization (WHO). It requires hospitals to 1) have a hand hygiene policy 2) promote hand hygiene 3) monitor compliance to the policies and provide feedbacks. [3]

Current methods for hand hygiene compliance monitoring include human observations or automated monitoring systems. [4] Direct human observation is likely to be affected by the Hawthorne effect: the propensity of people to behave differently when being observed. [5] Brotfain et al. tested the use of continuous closed circle television to monitor hand hygiene compliance, and while it seemed to have reduced the Hawthorne effect, limitations of the system led them to conclude that direct human observation was the most accurate monitoring method. [6]

Interventions to improve hand hygiene can be summarized in the following categories: education, reminders, feedback, provision of products, or combination of the above. [7]

2. Define

Observations had been showing decreasing hand hygiene compliance rate in the Medical ICU (MICU) in 2016. While radiology technologists largely contributed to the low rate (50%), the rate for nursing staff (71%) was still below average. This project was originated with the goal to improve hand hygiene compliance rate to 100% through targeted education / campaign to the front line staff. In addition, in order to capture more data points during this project and be able to assess the daily variation of the compliance rate, the use of an automated monitoring system was piloted.

A DMAIC methodology was applied to the project in order to Define the gap, Measure the baseline, Analyze the factors influencing the gap, Improve the performance and Control the improvements.

The timeline of the campaign itself was set to one month. The project as a whole included planning (two months), IT approval (two months), installation and adjustments of the monitoring system (three months), assessment of the

baseline measure (two weeks), campaign (one month), uninstallation of the system (two months) and closing (one month), the total timeline was therefore one year

Members from the Infection Prevention and Control (IPAC) program, the MICU nurse managers, and the MICU practice committee were part of the project team. While nursing staff was represented by the practice committee in the project team meetings, their input was also collected directly through an anonymous staff survey before the campaign, an anonymous comment board during the campaign, and another anonymous staff survey after the campaign.

3. Measure Phase

The electronic monitoring system: Smartlink© by Gojo was used to measure the hand hygiene compliance rate during the project. The system functions as follow:

- A motion sensor mounted above the doors captures the patient room entries / exits.
- Automatic dispensers for soap or foam have a built-in sensor that sends the “event” data to the cloud network.
- The system counts the total occurrences of hand hygiene (called “events”) and divides it by the number of room entries / exits (called “opportunities”) to obtain the hand hygiene rate.
- Data is displayed on a reporting dashboard where current performance can be accessed. The Smartlink © software contains various reporting options: hand hygiene compliance rate can be viewed for specific time periods or by specific locations. Raw data can also be exported to Excel and used for more in-depth analysis.

The target measure was the hand hygiene compliance rate, ratio of number of events over number of opportunities. Baseline was measured using the Smartlink© system over two weeks (14 days) between November 1st and 14th, 2016. Over those two weeks, total opportunities collected summed up to 138943, and hand washing events 42585 occurrences. It covered 28 rooms, two MICU units, both night and day shifts, all roles. The measured baseline was 30.6% when looking at the overall data collection. (Figure 1)

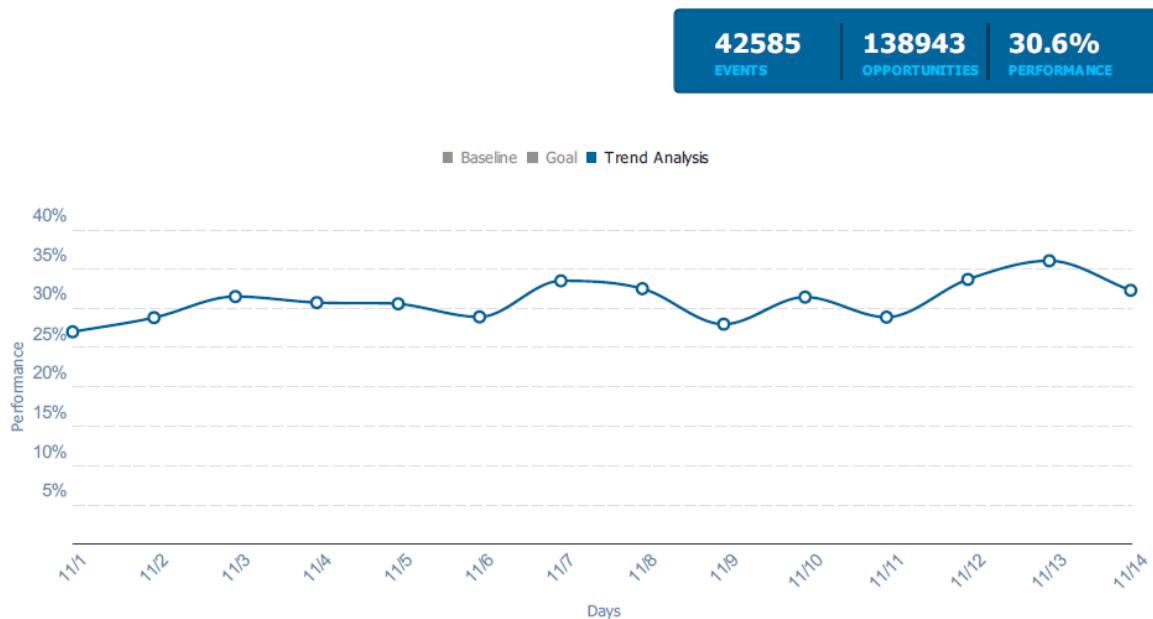


Figure 1: Overall hand hygiene compliance rate (baseline) for the MICU (Source: Gojo Smartlink® Software Dashboard)

Since the MICU was comprised of two units, it was decided to separate between the unit B and G. In addition, “days” were separated in a way that represented more accurately the practice: from 7am to 7am the next day, covering exactly two shifts (one day shift and one night shift). When separating the two units and counting by shifts

as described above, the hand hygiene compliance rate baseline was 29.7% for the unit B and 28.7% for the unit G. (Figure 2)

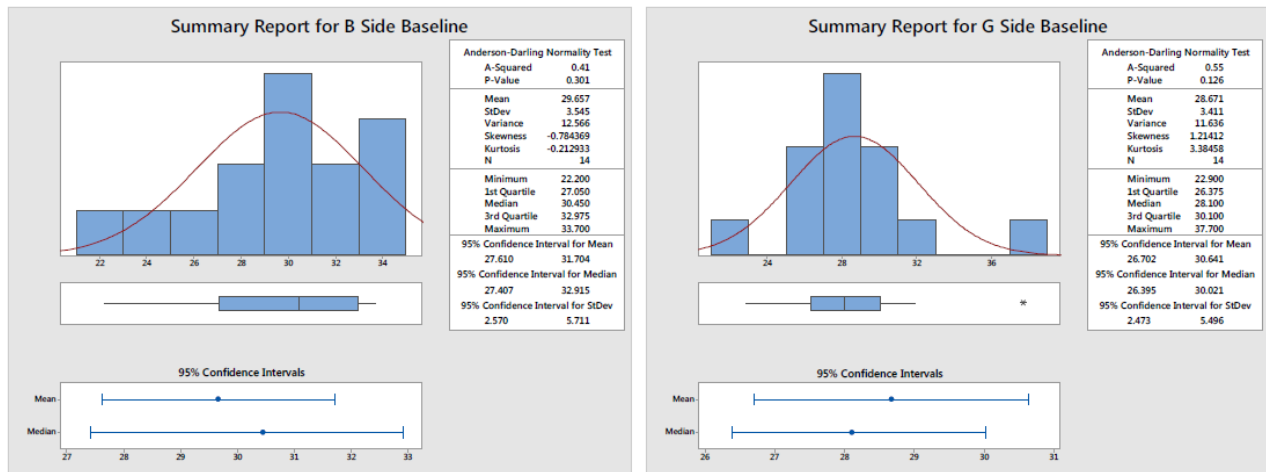


Figure 2: Graphical Summary of Baseline data separating by units and counting by shifts (Source: data from Gojo Smartlink® software, visualization in Minitab 17)

The seemingly low rates were explained by the limitations of the measuring system:

- Since the system captured all room entries / exit without distinction by role, not only visitors were accounted for, but also non-patient caring staffs (such as room cleaning, equipment maintenance, but also medical students or residents who were observing and did not have any patient contact, etc.). In addition, circulating patient-caring staff (e.g. Laboratory or Radiology staff), entering the patient rooms but using their own portable hand washing supply was also believed to bring the rate down. The Clinical support team from the vendor, Gojo, performed some observations to identify the percentage of room entries from the nursing staff. They collected 1934 data points over two days, both units, both night and day shift, and observed that room entries / exit by nursing staff represented 77.8% of total room entries / exit. Doctors (MD) and residents are patient-caring staff; however their entering the MICU rooms are mostly for rounding / checking on the patient and we decided not to include them in the compliance rate measurement.
- Feedback from the practice committee leaders was that a lot of tasks performed by nursing staff, despite entering the room, do not necessarily require hand washing. Such tasks include (but are not limited to): entering the room to talk with the patient or his family, hovering at the room's entrance to check with a nurse colleague at the nurse station, bringing material / equipment to another nurse performing care, etc. Since committee practice leaders were also direct care givers and thus direct users of the system, they accepted to validate the rate by comparing their self-count of hand hygiene to the rate obtained through the system. After comparing for several days through various shifts, the project team agreed to an average of 50% of room entries by nursing staff requiring hand hygiene.

The baseline measure was therefore adjusted in order to be comparable with the rate obtained through direct observations by IPAC. By adjusting the number of opportunities (138943) to 80% nursing, 50% of which required hand hygiene, the adjusted opportunities count would be 55577 and the adjusted Hand hygiene compliance rate 76.6%. (Table 1)

Table 1: Adjustment of Baseline measure

Opportunities (room entries / exit)	Occurrences (Hand washing)	Rate obtained through monitoring system	Opportunities (Adjusted)	Rate Adjusted
138943	42585	30.6%	55577.2	76.6%

Using this adjustment, a rate of 100% compliance would be equivalent to 39.9% measured through the automated monitoring system. (Table 2)

Table 2: Adjustment of Target Rate

Monitoring System Measure	Adjusted Hand Hygiene Compliance Rate
30.6%	76.6%
39.9%	100%

External benchmark target was also provided by the vendor: Gojo. The best hand hygiene compliance rate measured using their automated system was about 40% at another mid-west academic hospital, taking about two years to gradually improve. With the rate adjustment explained above, 40% would correspond to 100% compliance rate and a 38% improvement from the baseline. A rate of 40% using the automated monitoring system was therefore chosen as the target.

4. Analyze Phase

In order to specifically identify the most influential factors contributing to the gap, the team decided to use an Ishikawa diagram paired with a Pareto analysis and a 5 whys analysis.

A Cause & effects diagram (aka Ishikawa Diagram) (Figure 3) was selected to first summarize the potential barriers to hand hygiene brainstormed by the different groups / team members. It was quickly noticed that a lot of those factors could be addressed through an education campaign for the nursing staff. After brainstorming all the potential factors contributing to the gap, those factors were classified in 3 groups: factors that would be kept as out of scope in this project, factors that would be addressed in the education campaign, and factors that would be observed in the use of the automated monitoring system.

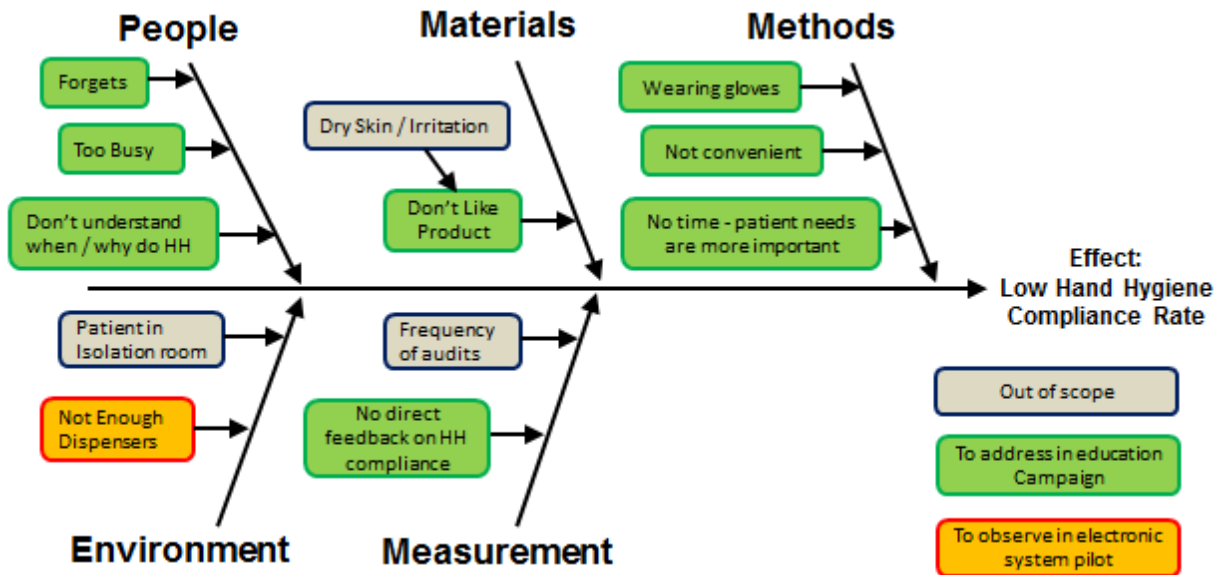


Figure 3: Cause & Effect Diagram

Then, the team narrowed down the potential barriers to hand hygiene to the top 5: Don't like the product, Not enough dispensers, Not convenient, Too busy, forgets. Voice of the customer (nursing staff) was collected through a RedCap Survey where they were asked to assess the extent to which a certain barrier was interfering with their performance of hand hygiene. Since we wanted to look at the most significant factors influencing hand hygiene, answers were summarized in a Pareto chart from the counts of "Very High" responses. (Figure 4)

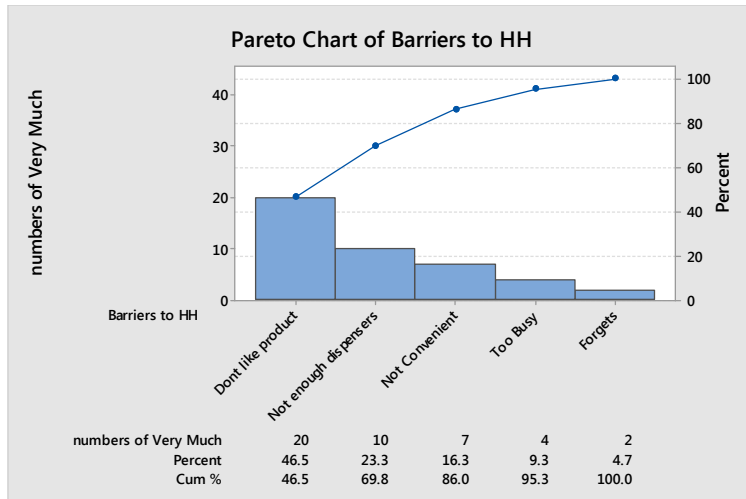


Figure 4: Pareto Chart of the barriers to Hand Hygiene (Data source: Redcap Staff Survey, chart in Minitab 17)

Results showed that “don’t like the product” and “not enough dispensers” were the two most influential factors, accounting for 70% of the total answers.

- Don’t like the product. In order to drill down deeper and find the root cause, a 5 whys analysis was performed, using staff comments that had been collected in the survey as well as direct input from the practice committee leaders during meetings. (Figure 5)

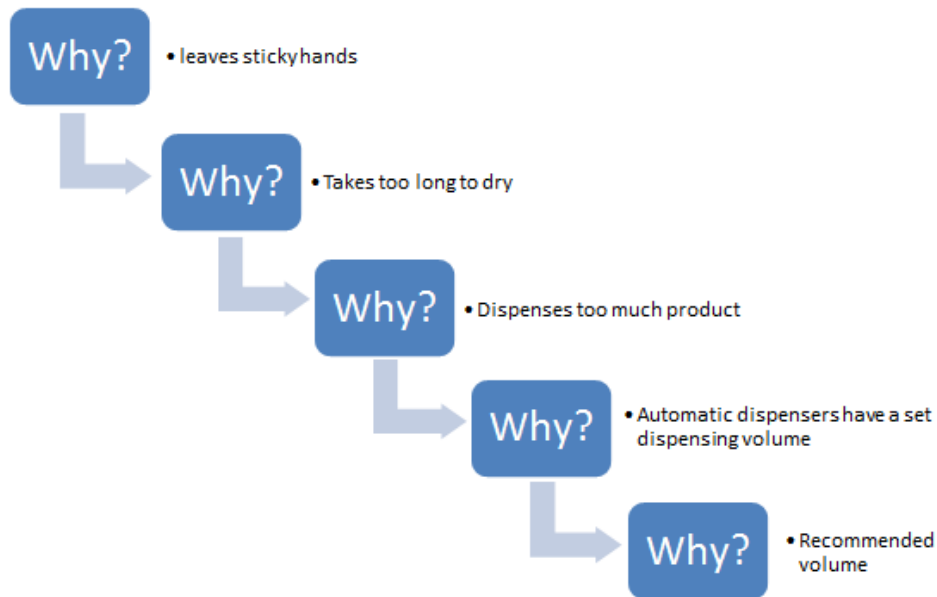


Figure 5: Barrier: “Don’t like product” 5 Whys Analysis

The project team realized that the automatic dispensers being piloted were dispensing automatically the recommended amount of product and this represented a difference from the classic system where staff dispenses from a bottle. The practice committee communicated with the staff, the rationale behind the amount dispensed by the automatic dispensers.

- Not enough dispensers. Gel bottles (with electronic monitoring) were added in each room, and the unit service coordinator was engaged to ensure dispenser refills were conducted when needed, so that each room has constantly at least one dispenser around the bed.

5. Improve Phase

Since the project team recognized that most factors identified as influencing the hand hygiene compliance rate were related to staff awareness, the intervention selected was an education campaign. The campaign was launched on November 16th and run for 3 weeks during which the project team met weekly, adjusting the actions and communication to the staff using a PDSA-like approach:

- First, the measured baseline rate and the target rate were announced to the nursing staff by the nurse managers. An email announcing the start of a campaign was sent to the nursing staff. MICU leadership was informed by email and asked to support the campaign. Education materials were distributed through emails to the nursing staff. Campaign was reinforced regularly at morning / evening huddles.
- PDSA 1: compliance rate display
 - The daily compliance rates were displayed daily on the staff board by the nurse managers.
 - After receiving feedback from the nursing staff on their desire to compare with baseline measure and see their progress, the display format was changed to a graph showing the evolution over time.
 - Encouragement emails were distributed when the rate reached the target.
- PDSA 2: staff feedback
 - Since various questions emerged during morning huddle, the Practice Committee Leaders took on a “hand hygiene champion” role. In addition to regularly reinforcing the education, they also provided direct feedback and answers to potential questions from the nursing staff,
 - The hand hygiene champions replaced the nurse managers in being the liaison between staff and project team to provide feedback and answers to potential questions.
 - An anonymous comment board was added so that staff comments can be continuously collected.

After launching the campaign and running continuous feedback / education for 3 weeks from November 16th to December 7th, re-measurement of the hand hygiene compliance rate took place between December 7th and 21st 2016. Over those two weeks, total opportunities collected summed up to 136559 (for the baseline, it was 138943), and hand washing events 56150 occurrences (for the baseline, it was 42585). It covered the same 28 rooms, two units, both night and day shifts, all roles... The re-measured average was 41.1% when looking at the overall data collection, which corresponds to an adjusted 102.9% compliance rate. The new average rate, using the same breakdown by shift and by unit, was 41% (103%) for the unit B and 44% (110%) on the unit G. Those results, compared to the baseline measures, shows that the hand hygiene compliance rate continuously improved during and after the education campaign, and thus that education campaign had a significantly positive effect. This achievement is even more significant when considering that the MICU staff reached in a month the target that it took years for the benchmark organizations to achieve. Hypothesis testing (Two-sample t-test) was performed and showed that this improvement over the baseline was statistically significant (P Value 0.000). (Figure 6)

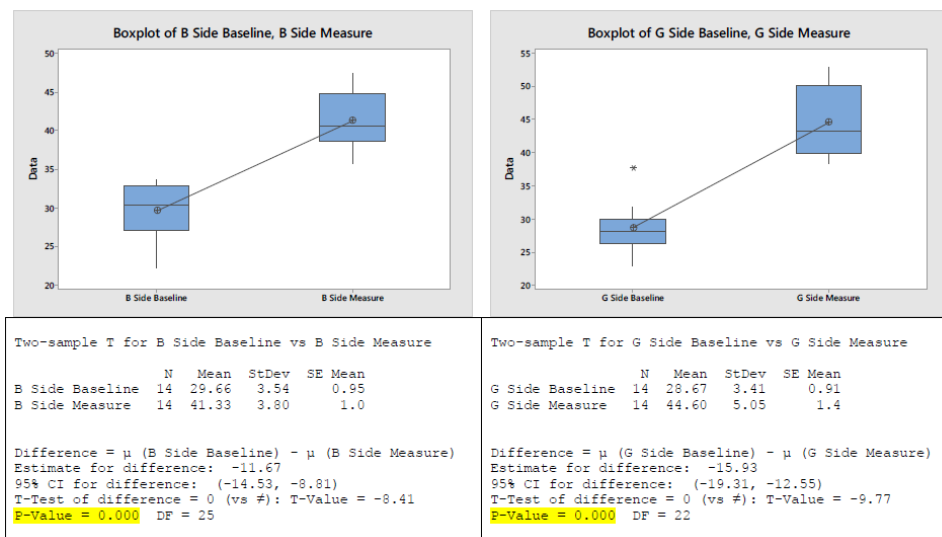


Figure 6: Boxplot and Minitab output for two-sample t-test of Baseline vs Target measures for each unit (data source: Gojo Smartlink©, analyzed in Minitab 17)

Before / After I-MR chart for each unit was also generated, and the results show that for both units the mean significantly increased. (Figures 7 & 8)

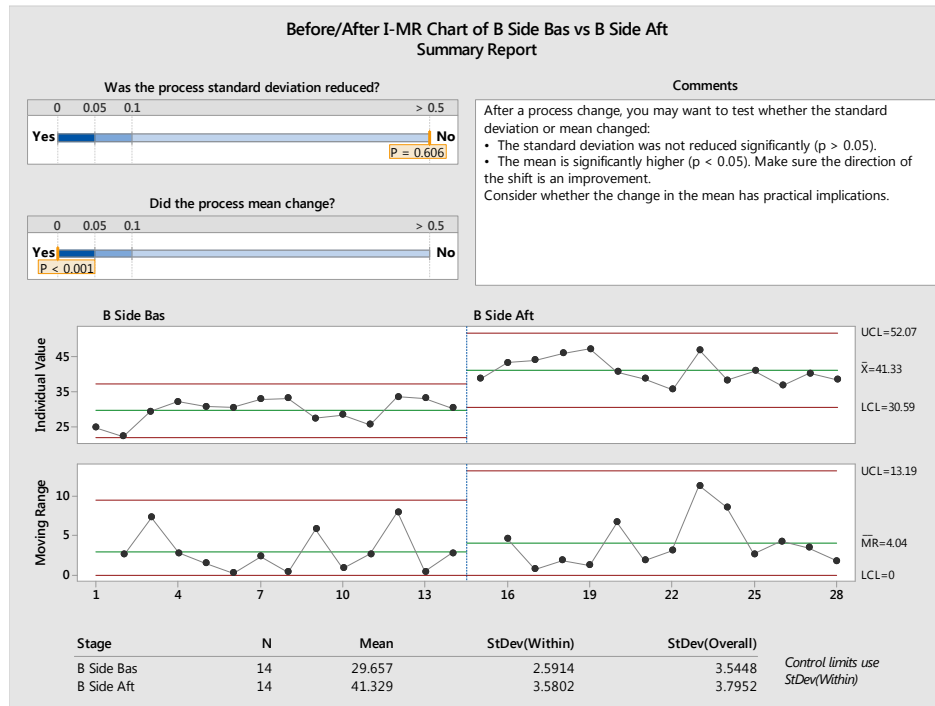


Figure 7: Before / After I-MR charts for the unit B (Source: data extracted from the Gojo Smartlink® monitoring software, analyzed in Minitab 17)

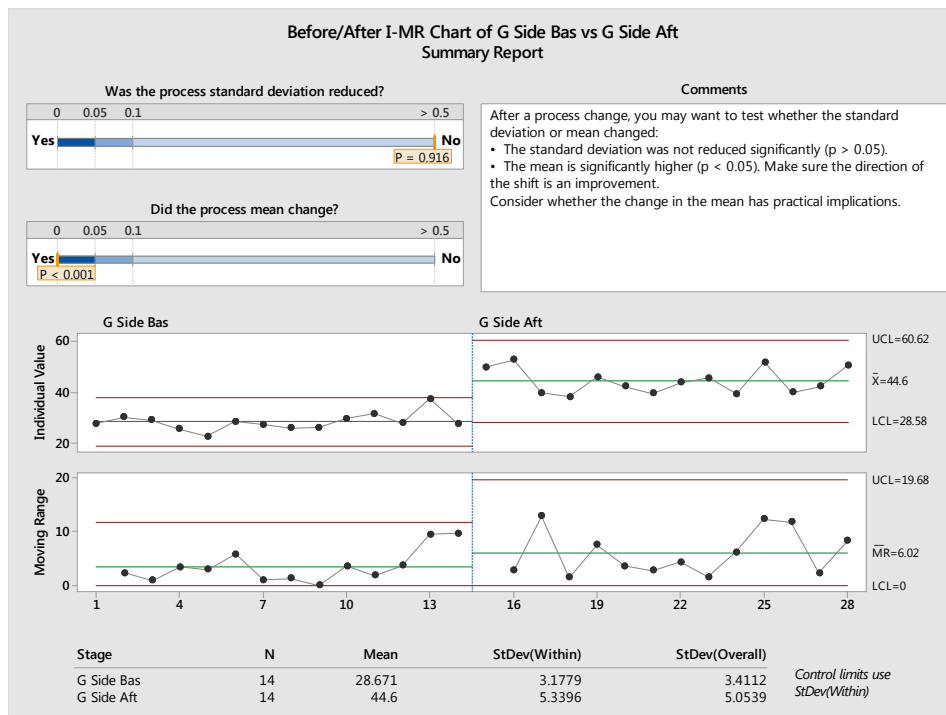


Figure 8: Before / After I-MR charts for the unit G (Source: data extracted from the Gojo Smartlink® monitoring software, analyzed in Minitab)

In addition, I-MR chart of the daily compliance rate after improvement show that the process is stable, with no point out of control. (Figures 9 & 10)

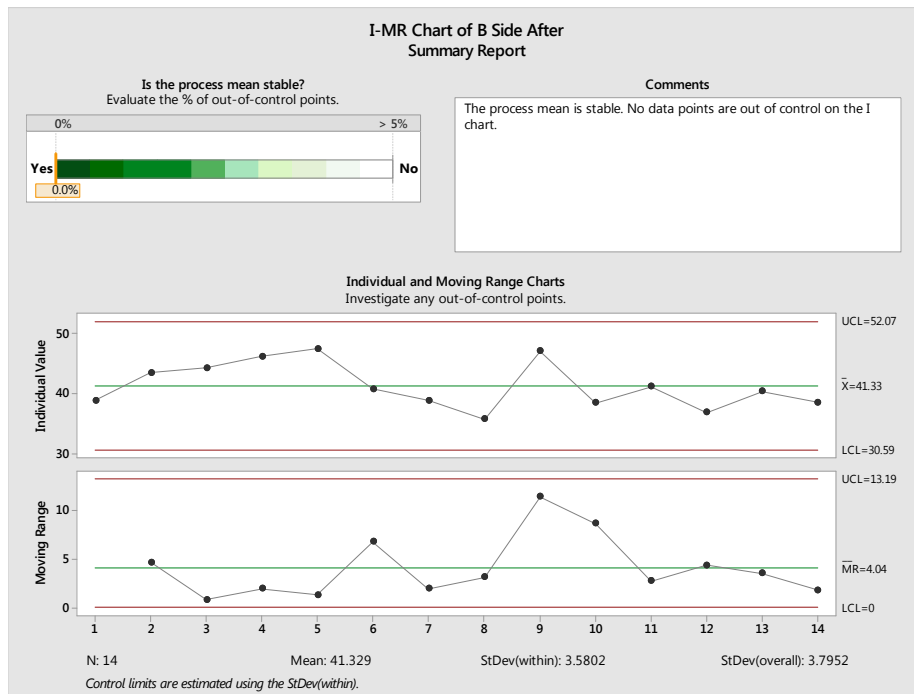


Figure 9: I-MR chart for daily compliance rate after campaign for the unit B (Source: data extracted from the Gojo Smartlink® monitoring software, analyzed in Minitab 17)

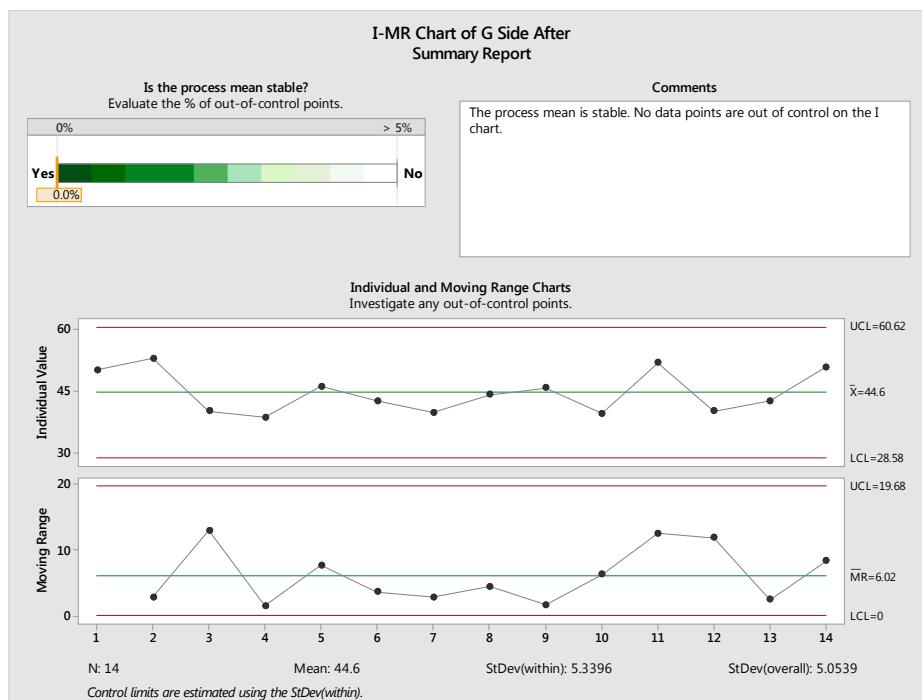


Figure 10: I-MR chart for daily compliance rate after campaign for the unit G (Source: data extracted from the Gojo Smartlink® monitoring software, analyzed in Minitab 17)

6. Control

The MICU nursing staff directly benefits from the campaign, and the knowledge gained about hand hygiene will help them to be more efficient and thorough in their hand hygiene habits. Education materials used during the campaign were kept on the unit, displayed on the unit board. The practice committee has taken ownership of the process, and will train new employees on the best hand hygiene practices as highlighted during the campaign.

The goal of the intervention selected: education campaign was to improve the hand hygiene rate by increasing staff awareness. To verify that this goal was achieved from a qualitative perspective, staff feedback were obtained through a Redcap Survey post-campaign. When asked “Since participation in this pilot and associated hand hygiene education, my attentiveness to performing hand hygiene to protect patients has increased?”, a total of 85% answered either Moderately (58.7%) or very much (26%), as opposed to only 15% who answered that it did not. (n= 46). (Figure 11)

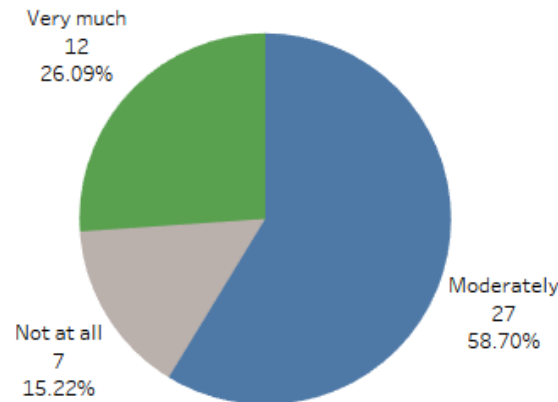


Figure 11: Staff Survey Results

Lessons learned were collected, summarized and documented:

- Targeted education, focusing on the rationale behind guidelines (when to perform hand hygiene, amount of product to use, etc.) has proven very effective in improving hand hygiene compliance rate. However, it is very time-consuming for leaders: nurse managers and committee practice leaders.
- Proper hand hygiene is not achieved by only washing hands when entering or leaving a patient room. “In-room hand hygiene” as highlighted in the “WHO 5 moments of hand hygiene”, i.e. hand washing between patient caring tasks is the most important.
- Both nursing staff and IPAC realized how complex the definition of hand hygiene compliance is, and that creating guidelines and recommendations on when to perform hand hygiene when moving from one patient care activity to the next represents an important challenge.
- Hand hygiene compliance rate monitoring was found to be very challenging as well. While an automated system has the advantage of giving continuous feedback, disadvantages include the inability to measure the actual hand hygiene opportunities as explained above. Boyce suggests that a combination of electronic monitoring paired with direct observations could be a solution to accurately measure the hand hygiene compliance. [8]
- Guidelines on hand hygiene while wearing gloves need to be explored further.

While significant improvement in the hand hygiene knowledge and thus compliance rate was achieved, ownership of the improved process by the process users is critical to ensure long-term sustainability of the improvements. The project was officially closed after project closing meeting, and process ownership was handed over to the MICU nurse managers and practice committee leaders. The transition plan is summarized as follow:

- The practice committee leaders will continue to assume their “hand hygiene champion” role. The role includes continuing to answer staff questions regarding hand hygiene, be the liaison between the staff and the leadership, but also ensure onboarding and education of the new staff.
- Nurse Managers will also continue to address specific hand hygiene questions and concerns, while making sure that the hand hygiene compliance rate stays satisfying and in control.

- IPAC will continue research and education on best hand hygiene practices (in room, etc.)
- Control Plan (Table 3): The Hand Hygiene compliance rate will be monitored quarterly by the MICU practice committee leaders with a goal of 100%, and reported to unit leadership and IPAC. In case of measure below the expected rate of 95%, measure will be taken by the unit leadership following the current IPAC guidelines.

Table 3: Control Plan

Control Subject	Subject Goal	Frequency of Measure	Criteria for Decision	Action/ Responsible Party	Analysis Method
Hand Hygiene Compliance Rate	100%	Quarterly	Lower than 95%	MICU Practice Committee Leaders Report to MICU Nurse Managers and IPAC	Direct observation

7. Conclusion

Good hand hygiene is a critical factor in preventing infection and providing high quality care. However, lack of understanding of the right hand hygiene practices (when to perform hand hygiene, how much product to use, etc.) can be a barrier to hand hygiene. Education and constant performance feedback has proven to be very effective in improving the hand hygiene practices and thus compliance rate. However, due to the complexity of defining perfect hand hygiene, challenges remain in the choice of the best compliance rate monitoring method, with each method presenting its pros and cons.

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