

Positive deviance: A program for sustained improvement in hand hygiene compliance

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Background: There is a paucity of data evaluating whether positive deviance (PD) can sustain improvement in hand hygiene compliance.

Methods: An observational study comparing the effect of PD on compliance with hand hygiene was conducted in two 20-bed step-down units (SDUs) at a private tertiary care hospital. In a 3-month baseline period (April-June 2008), hand hygiene counts were performed by electronic handwashing counters. Between July 1, 2008, and November 30, 2009, (East SDU) and between September 30, 2008, and December 2009 (West SDU), PD was applied in both units.

Results: There was more than a 2-fold difference in the number of alcohol gel aliquots dispensed per month from April 2008 (before PD) to November 2009 (last month in PD) in the East SDU. There was also a 2-fold difference in the number of alcohol gel aliquots dispensed per month from September 2008 (before PD) to December 2009 (last month in PD) in the West SDU. The difference in the rate of health care-associated infections (HAIs) between the baseline period and 2009 was statistically significant in the East SDU (5.8 vs 2.8 per 1,000 device-days; $P = .008$) and in the West SDU (3.7 vs 1.7 per 1,000 device-days; $P = .023$).

Conclusions: PD was responsible for a sustained improvement in hand hygiene in the inpatient setting and was associated with a decrease in the incidence of device-associated HAIs.

Key Words: Step-down unit; sustainability; alcohol gel; positive deviance strategy; observational study; epidemiology.

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Hand hygiene is considered one of the most important interventions to reduce health care-associated infections (HAIs).¹ Compliance with hand hygiene using alcohol-based preparations has increased over time, a trend that has not been observed with conventional agents.¹⁻⁴

Current guidelines from the Centers for Diseases Control and Prevention and World Health Organization aim to stimulate improvement in hand hygiene practices in all health care settings, and both guidelines recommend monitoring hand hygiene compliance in all

settings.^{1,5} Nonetheless, compliance rates below 50% have been reported worldwide, with the lowest rates usually reported in intensive care units (ICUs).¹⁻⁵

Strategies for improving health care workers' (HCWs) adherence to hand hygiene practices have been developed, including feedback on compliance.⁶ Feedback regarding product use has not resulted in significant improvements in hand hygiene compliance, however.⁷ Many studies have shown that adherence to hand hygiene recommendations remains poor, and that improvement efforts frequently lack sustainability.⁶

Positive deviance (PD) is a social and behavioral change process based on the premise that in most organizations and communities there are people or groups of people who solve problems better than colleagues with the exact same resources.⁸⁻¹⁰ We previously showed that PD resulted in a significant improvement in hand hygiene, which was associated with a decrease in the incidence of HAIs.¹¹ However, there is a paucity of data evaluating whether PD can sustain improvement in hand hygiene compliance.

Observers can follow HCWs to perform direct hand hygiene observations; however, given that our step-down rooms are private, HCWs would be prompted to

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clean their hands when observers were close to them (Hawthorne effect), which would not represent real-world conditions. Moreover, having observers walk into patient rooms violates patient privacy. The purpose of the present study was to evaluate the sustainability of a PD strategy for improving hand hygiene compliance in two similar adult step-down units (SDUs) using electronic handwashing counters.

METHODS

We conducted an observational study applying PD for improving hand hygiene in two 20-bed adult SDUs with the same physical layout between July 1, 2008, and November 30, 2009 (East SDU) and between September 30, 2008, and December 2009 (West SDU). During December 2009, the East SDU was closed for renovation. All of the rooms in these units are single-bed rooms. The study design was approved by the facility's Institutional Review Board.

Hand hygiene episodes were recorded by electronic handwash counters⁹ (SIGNOLTM 2109-01 model with no pager mode, catalogue number LIT-2109-INS2) for alcohol gel (Purell Hand Instant Sanitizer; 62% ethyl alcohol + 4% isopropyl alcohol in a 1-L bag [GOJO Industries, Inc., Brazil]). The alcohol gel dispenser (NXT 1-L model) records only one episode in any 2-second period even if more than one aliquot of alcohol is dispensed. Chlorhexidine dispensers (chlorhexidine 2%) also were available for use, but these dispensers did not have electronic counters. Both dispensers dispensed the same volume of product per use (approximately 1.3 mL) and were located inside the patient rooms. The total number of alcohol gel aliquots was determined, as was the total use of alcohol gel (L/1,000 patient-days).¹¹ In a previous study (citation here), we showed that HCWs in these SDUs preferred alcohol gel for hand hygiene, with alcohol gel representing 85% of the total volume of hand hygiene product used.

The initial positive deviants were identified by the two SDU nurse managers (L.R.G. and C.M.A.), but after the implementation of PD, the initial positive deviants identified other SDU colleagues who demonstrated good compliance with hand hygiene. Other HCWs, including physicians, physical therapists, speech pathologists, and nutritionists, then became interested in PD.

The process of PD for hand hygiene was changing HCWs' experiences, showing them how to improve hand hygiene practices and the best way to perform hand hygiene in the unit. Positive deviants were defined as those HCWs who wanted to change, to think, and to develop new ideas for improving hand hygiene and who stimulated other HCWs (including physicians) to use the alcohol gel product. These positive deviants

organized twice-monthly meetings with all SDU HCWs. These meetings included HCWs from all shifts and gave the positive deviants opportunities to express their feelings about hand hygiene, discuss needed improvements, and cite good examples of compliance. Along with changing the position of alcohol gel dispensers in the patient rooms and recommending a change in the pressure of the tap water, the meetings led to the decision to put alcohol gel dispensers in the SDU corridors and to train all SDU HCWs in hand hygiene performance. The positive deviants were attentive to both the quantity and quality of hand hygiene. They prepared laminated sheets on "My Five Moments for Hand Hygiene" (World Health Organization guideline on hand hygiene in health care settings) and incorporated this as the first page in all of the SDU patient medical records.

Our PD meetings include HCWs from all shifts (morning, afternoon, and night). At least one representative HCW attends from each shift. Meetings are held from 7:30 AM to 9:00 AM. During the meetings, the positive deviants discuss the general problems that they noticed (eg, Dr X did not wash his hands before a patient examination; Dr Y did not perform hand hygiene even after examining a patient in contact precaution). Participants discuss ways to stimulate a discussion with noncompliant individuals in a positive manner. No humiliation is permitted. The nurse managers facilitate the discussion and give the positive deviants opportunities to express their feelings about hand hygiene and to discuss what needs to be changed, what needs to be improved, what is wrong, and what is right (and should be taken as a good example). We encourage each of them to invite another positive deviant to the next meeting. There are different positive deviants at each meeting, with an average attendance of 35-40. The positive deviants are multipliers, which we believe is factor contributing to the success of the PD program. They are excited to see the final number of alcohol gel aliquots dispensed per SDU and to compare data and impressions.

After December 2008, the positive deviants were concerned about the sustainability of this approach to maintaining hand hygiene in both SDUs. Specifically, they were concerned about not transforming the PD meetings into tedious discussions reviewing the PD concept for new participants. Consequently, they applied motivational techniques, such as "six thinking hats," a process for managing meetings in which all participants get an equal voice and consensus is developed.¹² They also held interactive sessions in these meetings regarding controversial issues in infection control such as contact precautions, environmental issues, and care of invasive devices. Hand hygiene remained the primary theme, however. The meetings sometimes used videos that were created and edited by the positive deviants. At each meeting, the positive deviants reported the total

Table 1. Characteristics of the East and West SDUs during the study period

	East SDU		West SDU	
	2007	2009*	2007	2009
Unit demographics				
Patient-days	6869	6383	7203	6868
Monthly occupancy rate, %	94.5	93.6	94.8	90.4
Length of stay days, mean ± SD	11.4 ± 3.1	13.5 ± 2.8	11.8 ± 2.7	15.7 ± 3.6
Nurse–patient ratio in SDU	1:2.3	1:2.3	1:2.3	1:2.3
Device utilization rate [†]				
Urinary catheter	0.15	0.15	0.19	0.08
Central venous line	0.35	0.37	0.38	0.33
Tracheostomy	0.38	0.51	0.40	0.51
Device-associated infections, n	40	18 [‡]	27	12
Bloodstream infection/1,000 catheter-days, n	2.5	1.7	0.7	0.9
Urinary tract infection/1,000 catheter-days, n	14.9	12.7	9.6	12.2
Pneumonia/1,000 tracheostomy-days, n	7.3	0.6 [§]	4.2	0.9**
Incidence density of device-associated infections/1,000 patient-days, n	5.8	2.8 [¶]	3.7	1.7 ^{††}
Incidence density of HAIs/1,000 patient days, n	16.2	11.0	15.1	10.3 ^{‡‡}

*The East SDU was closed in December 2009 for renovation.

[†]Device-days/patient-days.

[‡]P = .037.

[§]P < .001.

[¶]P = .008.

^{||}P = .01.

**P = .01.

^{††}P = .023.

^{‡‡}P = .011.

number of counts from the dispensers for each patient room in which the HCW worked and discussed the HCW's performance, emphasizing that some patients have invasive devices, providing HCWs with many opportunities for performing hand hygiene. In this way, they promoted a healthy competition among HCWs regarding hand hygiene compliance. To be considered a positive deviant was a source of pride and provided recognition of good work.

We provided PD training for all SDU HCWs who used the dispensers, including nurses, physicians, physical therapists, speech pathologists, and nutritionists. These HCWs provided training for other hospital personnel, including lab technicians, radiology technicians, hospital volunteers, and chronic patient caregivers.

HAI surveillance during the study was performed by trained infection preventionists using Centers for Disease Control and Prevention definitions¹³ in both units. Length of stay, occupancy rate, nurse–patient ratio, and invasive device utilization ratios were calculated for the duration of the study.

All statistical analyses were performed using SPSS 13.0 (SPSS Inc, Chicago, IL). Differences in proportions between the baseline data (year 2007) and the last year in the study (2009) were analyzed using the χ^2 test and *t* test for equal variances. The Mann-Whitney *U* test was used for nonnormally distributed continuous variables. All tests of statistical significance were two-sided, with the significance level set at *P* = .05.

RESULTS

Study sample, compliance, and demographic characteristics

Unit demographic data are given in Table 1. No differences were found between study periods in either unit in terms of length of stay, nurse–patient ratio, or the utilization of urinary catheters, central venous catheters, and tracheostomy. There was a >2-fold difference in the number of alcohol gel aliquots dispensed per month from April 2008 (before PD) to November 2009 (last month in PD) in the East SDU, and a >3-fold difference in the number of liters of alcohol gel used per 1,000 patient-days (Fig 1). In the West SDU, there was a 2-fold difference in the number of alcohol gel aliquots dispensed per month from September 2008 (before PD) to December 2009 (last month in PD), and a nearly 4-fold difference in the volume of alcohol gel used (Fig 2).

Infection rates

There was a statistically significant reduction in the incidence density of all HAIs between 2007 and 2009 in the East SDU (16.2 vs 11.0/1,000 patient-days; *P* = .01) and in the West SDU (15.1 vs 10.3; *P* = .011) (Table 1). Significant differences also were seen for device-associated infections in both units. In the East SDU, the incidence density of device-associated infections/1,000 patient-days was 5.8 in 2007, compared with

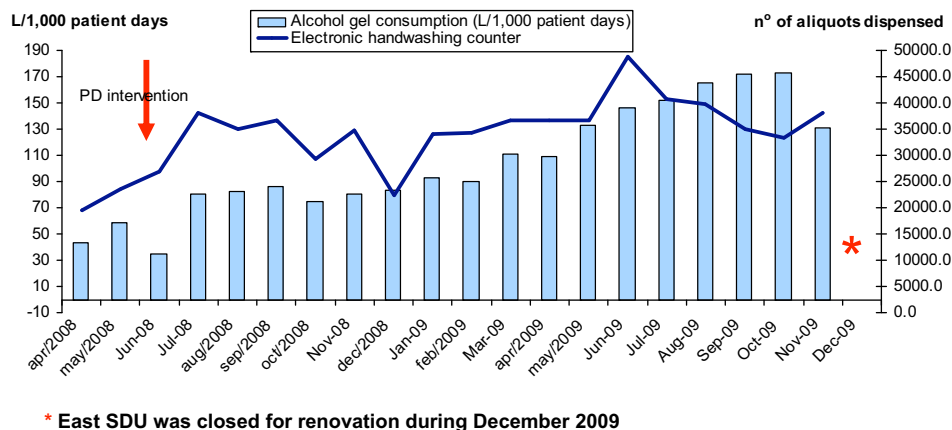


Fig 1. Relationship between alcohol gel consumption (L/1,000 patient-days) and the electronic handwashing counter in the East SDU during the study period.

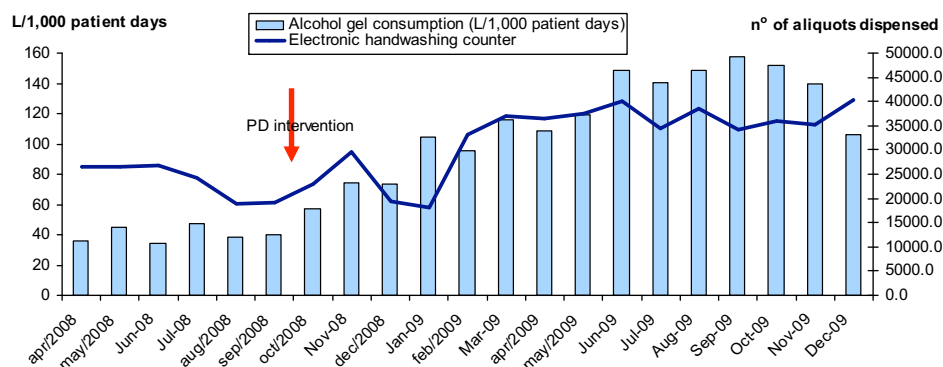


Fig 2. Relationship between alcohol gel consumption (L/1,000 patient-days) and the electronic handwashing counter in the West SDU during the study period.

2.8 in 2009 ($P = .008$). In the West SDU, this rate fell from 3.7 in 2007 to 1.7 in 2009 ($P = .023$). When evaluating the device-associated HAIs individually, the primary effect was noted for pneumonia (East SDU: 7.3 vs 0.6 [$P = .001$]; West SDU: 4.2 vs 0.9 [$P = .01$]).

DISCUSSION

We have been working with the PD concept for hand hygiene since July 2008,¹¹ believing that it is possible to improve hand hygiene compliance by developing a sense of ownership among HCWs and demonstrating that hand hygiene is the most important tool for decreasing HAIs. The introduction of alcohol gel products led to a significant and sustained improvement in the rate of hand hygiene adherence,^{6,14} however, the introduction of alcohol gel products alone without an associated behavioral modification program has proven ineffective.¹⁵⁻¹⁷ Although the recently published “Five Moments for Hand Hygiene” emerged from the World Health Organization’s guidelines on hand hygiene in health care to add value to any hand hygiene improvement strategy,¹⁸ hand hygiene compliance rates

remain only ~50% in many medical centers in which alcohol gel use has been implemented.^{15,19}

The two SDUs in the present study have a similar mix of patients. The SDU patients were transferred from the medical-surgical intensive care unit of this hospital, from wards, and from the emergency department. Importantly, no differences in potential confounders were observed between the units over the course of the study, including length of stay, nurse–patient ratio, and invasive device use.

The electronic handwashing counter was an important tool for collecting information regarding hand hygiene, allowing us to provide feedback to positive deviants about their hand hygiene performance. The positive deviants are excited to see the final number of alcohol gel aliquots dispensed per SDU and to compare numbers with one another. Today, nearly 50,000 alcohol gel aliquots per month are dispensed in the East SDU, compared with fewer than 20,000 before institution of the PD program (Fig 1). Other studies have demonstrated that electronic monitoring of alcohol gel use can provide a useful indicator of workloads in hospital units.^{20,21} Boyce et al²² used these electronic devices

to provide specific data on how frequently HCWs used alcohol-based hand rub dispensers when performing hand hygiene (ie, time of day and day of the week), revealing the locations of dispensers with the highest and the lowest rates of use. These electronic handwashing counters have yielded details about patterns of alcohol gel use beyond the liters of alcohol gel used per 1,000 patient-days.²⁰⁻²² In the present study, these electronic dispensers provided data showing a trend in the number of hand hygiene episodes per month since the introduction of PD in the SDUs. We have a nurse who obtains the data from the electronic counters in the SDUs every 48 hours; however, positive deviant workers count hand hygiene episodes before the next shift (morning, 6 hours; afternoon, 6 hours; night, 12 hours) to demonstrate the HCW's performance in each room.

Because there is no sensitive method for distinguishing which infections can be avoided by hand hygiene, we decided to show both the device-associated infection rate and all HAI rates per 1,000 patient-days in the SDUs during the study period. PD for hand hygiene was among the various interventions that could have contributed to the decreased HAI rates in our units, especially for bloodstream infections associated with central venous catheters and pneumonia associated with tracheostomy.

This study has several limitations. First, this is not a randomized trial, but rather a quasi-experimental, interrupted time series study. Quasi-experimental study designs are frequently used when a controlled trial is not logistically feasible.²³ In our case, it would be unethical to develop a controlled trial for evaluating the sustainability of PD once we proved¹¹ that PD can improve hand hygiene compliance. Second, we did not visually assess hand hygiene compliance before and after patient contact, nor did we evaluate the handwashing technique. However, the Hawthorne effect might interfere with an observational study in which handwashing is being observed directly.²⁴ Third, because this intervention was performed at a single medical center, these results might not be generalizable to other hospitals.

In conclusion, based on our findings, PD can be considered an intervention to sustain improved hand hygiene compliance and can be associated with a decreased incidence of device-associated HAIs.

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References

1. Boyce JM, Pittet D. Healthcare Infection Control Practices Advisory Committee, HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. 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.
2. Voss A, Widmer AF. No time for handwashing! Handwashing versus alcoholic rub: can we afford 100% compliance? *Infect Control Hosp Epidemiol* 1997;18:205-8.
3. Pittet D, Hugonnet S, Harbarth S, Mouroga P, Sauvan V, Touveneau S, et al. members of the Infection Control Programme. Effectiveness of a hospital-wide programme to improve compliance with hand antisepsis. *Lancet* 2000;356:1307-12.
4. Bischoff WE, Reynolds TM, Sessler CN, Edmond MB, Wenzel RP. Handwashing compliance by health care workers: the impact of introducing an accessible, alcohol-based hand antiseptic. *Arch Intern Med* 2000;160:1017-21.
5. World Health Organization. WHO guidelines on hand hygiene in healthcare (advanced draft): a summary. Geneva, Switzerland: World Health Organization; 2009.
6. Gould DJ, Chudleigh JH, Moralejo D, Drey N. Interventions to improve hand hygiene compliance in patient care. *Cochrane Database Syst Rev* 2007;2: CD005186.
7. Marra AR, D'Arco C, Bravim Bde A, Martino MD, Correa L, Silva CV, et al. Controlled trial measuring the effect of a feedback intervention on hand hygiene compliance in a step-down unit. *Infect Control Hosp Epidemiol* 2008;29:730-5.
8. Gawande A. *Better: a surgeon's notes on performance*. New York: Metropolitan Books; 2007.
9. Marsh DR, Schroeder DG, Dearden KA, Sternin J, Sternin M. The power of positive deviance. *BMJ* 2004;329:1177-9.
10. Positive Deviance Initiative. Available at: <http://www.positivedeviance.org>. Accessed May 23, 2010.
11. Marra AR, Reis Guastelli L, Pereira de Araújo CM, Saraiva Dos Santos JL, Lamblet LC, Silva MJr, et al. Positive deviance: a new strategy for improving hand hygiene compliance. *Infect Control Hosp Epidemiol* 2010;31:12-20.
12. De Bono E. Six thinking hats. Available from: <http://www.cabre.co.uk/sixthinkinghats.html>. Accessed May 23, 2010.
13. Garner JS, Jarvis WR, Emori TB, Horan TC, Hughes JM. CDC definitions for nosocomial infections. *Am J Infect Control* 1988;6:128-40.
14. Rupp ME, Fitzgerald T, Puumala S, Anderson JR, Craig R, Iwen PC, et al. Prospective, controlled, cross-over trial of alcohol-based hand gel in critical care units. *Infect Control Hosp Epidemiol* 2008;29:8-15.
15. Whitby M, McLaws ML, Slater K, Tong E, Johnson B. Three successful interventions in health care workers that improve compliance with hand hygiene: is sustained replication possible? *Am J Infect Control* 2008;36:349-55.
16. Gawande A. On washing hands. *N Engl J Med* 2004;350:1283-6.
17. Bittner MJ, Rich EC, Turner PD, Arnold VH Jr. Limited impact of sustained simple feedback based on soap and paper towel consumption on the frequency of handwashing in an adult intensive care unit. *Infect Control Hosp Epidemiol* 2002;23:120-6.
18. Sax H, Allegranzi B, Uçkay I, Larson E, Boyce J, Pittet D. "My five moments for hand hygiene": a user-centered design approach to understand, train, monitor and report hand hygiene. *J Hosp Infect* 2007;67:9-21.
19. Novoa AM, Pi-Sunyer T, Sala M, Molins E, Castells X. Evaluation of hand hygiene adherence in a tertiary hospital. *Am J Infect Control* 2007;35:676-83.
20. Kinsella G, Thomas AN, Taylor RJ. Electronic surveillance of wall-mounted soap and alcohol gel dispensers in an intensive care unit. *J Hosp Infect* 2007;66:34-9.
21. Haas JP, Larson EL. Measurement of compliance with hand hygiene. *J Hosp Infect* 2007;66:6-14.
22. Boyce JM, Cooper T, Dolan MJ. Evaluation of an electronic device for real-time measurement of alcohol-based hand rub use. *Infect Control Hosp Epidemiol* 2009;30:1090-5.
23. Harris AD, Bradham DD, Baumgarten M, Zuckerman IH, Fink JC, Perencevich EN. The use and interpretation of quasi-experimental studies in infectious diseases. *Clin Infect Dis* 2004;38:1586-91.
24. Gould DJ, Chudleigh J, Drey NS, Moralejo D. Measuring handwashing performance in health service audits and research studies. *J Hosp Infect* 2007;66:109-15.