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SEQUENTIAL LOW COST INTERVENTIONS DOUBLE HAND HYGIENE RATES AMONG MEDICAL TEAMS IN A RESOURCE LIMITED SETTING. RESULTS OF A HAND HYGIENE QUALITY IMPROVEMENT PROJECT CONDUCTED AT UNIVERSITY TEACHING HOSPITAL OF KIGALI (CHUK), KIGALI, RWANDA

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O. MANZI AND O. OGBUAGU

ABSTRACT

***Objective*: To assess the impact of multimodal low-cost interventions on hand hygiene practices among medical teams.**
***Design*: A four week prospective observational study**
***Setting*: Medical wards of the University Teaching Hospital of Kigali (CHUK), Kigali, Rwanda.**
***Subjects*: Medical teams comprising students, residents and consultant physicians.**
***Interventions*: During week one, baseline hand sanitising rate (HSR) – the percentage of hand hygiene opportunities during which hands were sanitised- was recorded. On week two, alcohol based handrubs (ABHRs) were provided and placed strategically on every ward. For week three and four respectively, hand hygiene posters (HHPs) were placed at entry sites of each ward at eye level and subsequently at the head of each patient's bed.**
***Main Outcome Measures*: Post-intervention HSR was recorded weekly during morning ward rounds. The differences between pre-intervention and post-intervention HSRs as well as end-of-study pre- and post-contact HSR were assessed for significance using Pearson chi square test.**
***Result*: A total of 780 HHOs were covertly observed throughout the study. Baseline HSR was 24.8%. During week 2, there was a non-significant increase in HSR (26.6% vs. 24.8%, p =0.66). Overall, hand sanitising rates doubled from 24.8% to 50.6% following all study interventions (p <0.001). There was a significant increase in post-patient contact and pre-patient contact HSRs with rates improving from 25.2% to 58% and 24.5% to 43% respectively (P<0.01).**
***Conclusion*: Our study showed that low-cost interventions involving ensuring availability of ABHRs and posting HHPs significantly increased HSRs among medical teams but post-intervention rates were suboptimal.**

INTRODUCTION

Adherence to recommended hand hygiene (HH) practices is known to be poor among healthcare workers (HCWs) in general, and physicians in particular, in developed and developing countries alike (World Health Organization (WHO), 2009) (1). Poor hand hygiene practices are associated with nosocomial transmission of healthcare associated infections (HCAIs), including promoting endemicity and outbreaks of drug resistant pathogens worldwide (2). These concerns informed the WHO initiative "Clean Care is Safer Care" campaign launched in 2005 which, in part, is aimed at increasing awareness of the importance of HH and encouraging implementation of successful HH improvement methods with the principal goal of decreasing rates of HCAIs worldwide (1).

Improved HH among HCWs is recognised as the foremost and an essential step to decreasing largely preventable HCAIs; as well as its associated morbidity,

mortality and financial burden to healthcare systems (3, 4). This is especially important in low-resource settings where limited availability of hand hygiene products and running water, poor sanitation, overcrowding of patients due to insufficient space and structures in healthcare facilities, high physician and/or nurse-to-patient ratios, and inability to isolate patients with resistant pathogens remain significant obstacles to infection control (1,5). In designing interventions to improve hand hygiene in such environments, cost and sustainability of interventions are critically important considerations to any long-term successful infection control campaign.

Alcohol -based handrubs (ABHRs) are the preferred choice for hand sanitising in most healthcare settings and its use has been associated with improved hand hygiene compliance (6). ABHRs are widely available, easy to use, and may be produced locally where needed. However simple provision and availability of ABHRs in healthcare settings does not necessarily translate to their appropriate use (7). An intervention which has proven effective in improving HH compliance is the use of HH poster reminders (1). Despite proven success of individual strategies in improving HH rates, multimodal intervention strategies are recognised as resulting in superior outcomes and recommended in the most recent WHO guidelines on Hand Hygiene in Healthcare (1, 2).

There is limited data from resource limited settings especially sub-Saharan Africa, not only on the utility, but the impact of strategies known to improve HH in other settings such as implementing system change including investment in provision and availability of HH products and use of poster reminder tools. We studied and report the impact of sequential multimodal low-cost strategies on HH practices among medical teams in Kigali, Rwanda.

MATERIALS AND METHODS

Study design/setting: Our study was conducted as a four week prospective non-randomised observational study on the impact of sequentially introduced low cost interventions on HH behavior. The study site was all three blocks of the male medical ward of the largest hospital in Rwanda, the University Teaching Hospital of Kigali (CHUK). The blocks comprised cardiology (block 1), gastroenterology (block 2) and infectious diseases wards (block 3).

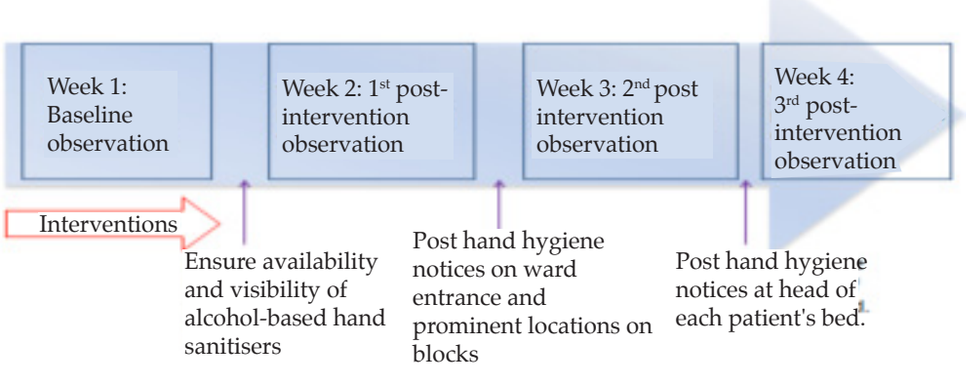
Study subjects: Our intervention subjects were in-patient medical teams comprising rotating medical students, internal medicine residents and their supervising consultant internists and/or sub-specialists.

Study interventions: Three interventions were introduced sequentially during the specified study period. The first intervention consisted of ensuring that sufficient quantities of ABHRs were available on each block and placed at locations within visual proximity of rounding medical teams usually on mobile carts where patient paper based charts were placed. The next intervention involved placement of HH posters on the walls at the entrance of the ward and on each block at eye-level. Lastly, HH posters were placed at the head of each patient's bed also at eye-level. Preceding interventions were maintained with introduction of new ones (see Figure 1).

HH Observation methods: Rotating medical students (1 student per block) were trained to covertly observe and record HH practices during morning ward rounds. HH opportunities included periods before and after contact with patients or their fomites, handling their body fluids or performing procedures as specified by WHO "my 5 moments for hand hygiene" model. Observations were performed during one to two days of each study week - at baseline (week 1) and following the introduction of each study intervention (weeks 2-4). Compliant hand hygiene practice was defined as use of alcohol based hand rub or hand washing as described by WHO "my 5 moments for hand hygiene."

Figure 1

Schematic representation of study design



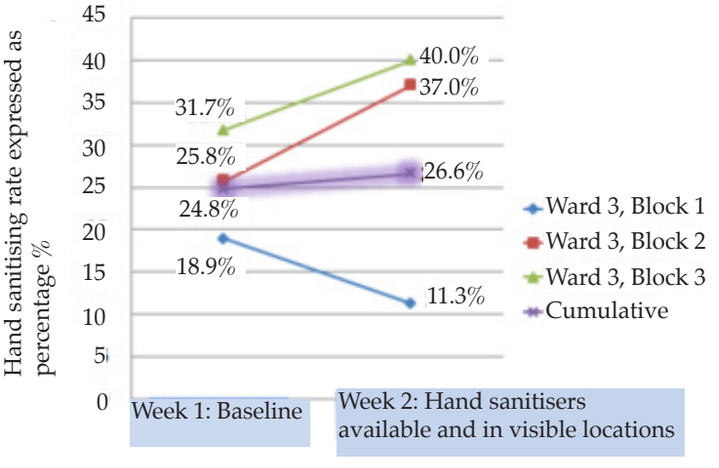
Study data analysis/statistics: HH opportunities (HHOs) included moments before and after contact with patients or their fomites as well as before and after performing procedures. We defined hand sanitisation rate (HSR) as the percentage of total HHOs during which hands were observed to be appropriately sanitised, that is, hand sanitising action (HSA) divided by hand hygiene opportunities (HHO) multiplied by 100. The impact of each weekly intervention on the HSR was recorded. The differences between pre-and post-intervention HSRs were assessed for significance using Pearson chi square test or Fisher's exact test as appropriate. The differences between end-of-study pre-contact HSR and post-contact HSR were also assessed for significance using Pearson Chi Square test. P values <0.05 were accepted as statistically significant. Statistical software used was IBM SPSS version 19.0.

RESULTS

A total of 780 HHOs were observed throughout the entire study period comprising 278, 184, 156 and 162 HHOs during weeks one, two, three and four respectively. On week one of the study, observed baseline HSR ranged from 18.89% to 31.67% with a composite average of 24.8%. The average HSR pre-patient contact was 25.17% while post-patient contact HSR was 24.46%.

During week two, following the provision and strategic placement of hand sanitisers, there was a non-significant increase in overall HSR compared to baseline (26.6% vs. 24.8%, p =0.66). This was driven by an increase in HSR in two out of three wards where HH observations occurred as there was also a decline in one ward (see Figure 2).

Figure 2
Change in hand sanitising rate from week one to week two of study



There was incremental improvement of hand hygiene behavior with subsequent interventions. Overall HSR at week three was 40.4% and by week four had improved to 50.6% (Table 1). Overall, hand sanitising rates doubled from baseline of 24.8% to 50.6% at the end of study (p <0.001).

Table 1
Impact of study interventions on hand sanitising rates over time

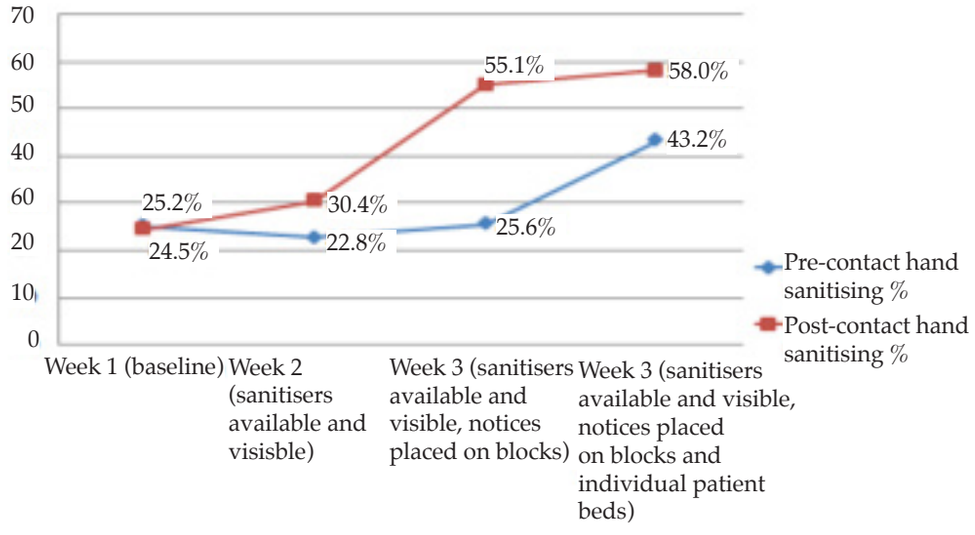
Week of study	Pre-contact HSA/HHO(%)	Post-contact HSA/HHO (%)	Total HSA/HHO (%)	P value (Chi square test)	
Week 1	35/139 (25.2)	34/139 (24.5)	69/278 (24.8)		
				0.66	
Week 2	21/92 (22.8)	28/92 (30.4)	49/184 (26.6)		
				0.007	<0.001
Week 3	20/78 (25.6)	43/78 (55.1)	63/156 (40.4)		
				0.067	
Week 4	35/81 (43.2)	47/81 (58.0)	82/162 (50.6)		

HSA-hand sanitising action, HHO-hand hygiene opportunity, HSR- hand sanitization rate; HSA/HHO= HSR. P values < 0.05 are significant.

Post-patient contact HSRs and pre-patient contact HSRs both showed improvement from baseline to end of study HSRs of 25.2% to 58% and 24.5% to 43% (P<0.01) respectively (see Figure 3). Therefore though both rates were similar at baseline, there was almost twice as much improvement in post-contact HSR than pre-contact HSR (137% vs. 71%) but the difference at the end of the study did not meet but closely approached statistical significance (p = 0.059).

Figure 3

Effect of study interventions on pre- and post-patient contact hand hygiene practices



*P-value represents difference between end-of-study study pre- and post- contact hand sanitising rate (week 4).

DISCUSSION

Hand hygiene adherence among healthcare providers is notoriously low and remains a significant challenge to infection control in hospital settings (8). Poor hand hygiene practices have been clearly linked with transmission of healthcare associated infections (HCAIs) (9). HCAIs contribute to excess morbidity and mortality among hospitalised patients and pose a significant economic burden to health systems. It is also known that HCAIs disproportionately impact low resource countries and interventions to change this trend are sorely needed (1).

Interventions to improve hand hygiene while successful do not always result in optimal outcomes (10). While the most ideal goal is a 100% hand hygiene compliance by healthcare workers, a greater than 90% adherence rate is a more realistic and achievable target and is the current standard promoted by healthcare regulatory bodies such as the United States Joint Commission for Accreditation of Hospitals (JCAHO) (8). According to a center for disease control and prevention (CDC) report, the median hand hygiene compliance rate among HCWs after various hand hygiene promotion efforts was 60% (range 7-92%). Out of 22 studies which reported post-intervention hand hygiene compliance, only two reported rates >90% (11).

Our observed baseline (pre-intervention) hand hygiene rates of 24.8% are similar to those reported by other centers. Per 2009 WHO report, baseline rates of hand hygiene among healthcare workers in developed and developing countries averaged 38.7% (range 5-89%) (1). An observational study in a large teaching hospital in Ghana revealed patient care related hand hygiene compliance rates among doctors of 9.2-57% (12). The cumulative impact of our study interventions resulted in a remarkable doubling of HSRs from 24.8% to 50.6% (p<0.001). Because observations were conducted covertly, we eliminated the "Hawthorne" effect on HH behaviour. While our results were impressive with our low cost and low effort hand hygiene promotion strategies, post-intervention results remain sub-optimal suggesting the need for additional interventions to achieve the elusive goal of greater than 90% compliance. This supports the recommendation by the WHO that multimodal strategies are most likely to be successful and result in optimal compliance with hand hygiene recommendations.

In our study, the provision and strategic placement of ABHRs did not significantly impact hand hygiene compliance rates. This has been observed in other studies which have also shown similar lack of effect of the intervention as a stand-alone strategy for hand hygiene promotion. For example, in a study by Harbarth, S *et al*, the introduction of ABHRs in a pediatric cardiac intensive care unit (ICU) did not

improve hand hygiene compliance rates, rather there was a slight decline (13). This supports the notion that hand hygiene is predominantly a conditioned or prompted action that is not impacted solely by the availability of antiseptics with absolute requirement for interventions aimed at improving behavior. However, the lack of effect of provision of ABHRs does not necessarily imply that unavailability does not impact hand sanitising rates. Ensuring the availability of ABHRs is clearly important and remains integral to hand hygiene promotion efforts (14). Obviously, if ABHRs are not readily available and easily accessible, they cannot be used.

We were impressed at the degree of success of our study interventions which utilised HH posters as a reminder tool in large hospital wards with open layout. In most developed countries, hospitals have adopted the use of single or double patient rooms and poster reminder tools placed at room entrances may have more impact as they confront the HCW upon entering the rooms. It is remarkable that the impact of our study interventions on HH compliance approximates those of other studies with hospitals with different ward formats which utilised similar strategies (13,15). This might be explained by strategic positioning of hand hygiene posters at eye level which we think played a significant role in our study outcomes.

In our study, we found that our interventions had more impact on post-contact HSR than pre-contact HSR and the difference closely approached statistical significance. A similar study performed in two outpatient clinics in Kansas, USA utilising poster reminders also noted better post-contact HSRs compared with pre-contact HSRs (16). The differential impact on post-contact hand hygiene behavior is likely multifactorial including the reminder effect of poster notices. We hypothesise that rates may also be lower pre-patient contact because of the perception that if hands were sanitised after the last patient contact, they do not need to redone before the next patient contact especially if no new contact with any devices or fomites or environment occurred. However, it is recognised that hand recontamination can also occur from inanimate and non-patient associated objects including finger rings (17) and stethoscopes (18) which are touched in between patient encounters.

Our study had several limitations. Long term trends in hand sanitising behavior were not assessed. It is possible that the short term trends we observed may be sustained, improved or could decline over time without additional interventions. Evidence suggests that the latter scenario is more common (19). It is plausible that the reminder effect of hand hygiene posters may be diminished over time due to over-familiarity with the notices. Also, while morning rounds represent the time of highest volume of patient interactions by healthcare workers in our hospital setting, hand sanitising behaviour during rounds may not reflect behaviour at later times of the day, during performance of medical procedures when gloves are more likely to be used or during emergent situations. In addition, HCW and patient interactions during morning rounds reflects only a minority of interactions over the course of the day.

With any study assessing the impact of sequentially introduced interventions on the same outcome, the impact of preceding intervention may have impacted results of the subsequent one. However it offers the advantage of studying the impact of each intervention separately. The medical student component of teams changed once midway through the study (in between weeks two and three of the study). If anything, this may have resulted in an underestimation of the cumulative effect of our study interventions as there would have been a loss of effect of preceding interventions on HH compliance of the new student rotators.

It is important to also emphasise that our study was conducted on internal medicine wards and baseline HSR as well as improvement with interventions may not be reflective of trends or applicable to other specialty wards or intensive care units with differing levels of intensity of patient care. Also multiple studies show that physicians, which we studied and compared to all other categories of healthcare workers, have relatively poor hand hygiene compliance. For example, a very large study performed by Pittet D. *et al* in a large teaching hospital in Geneva showed that physicians, compared to nurses, had significant lower HH compliance (odds ratio(OR) 2.8, 95 confidence interval (CI) 1.91-4.10); and surgical wards and intensive care units had worse HH compliance than internal medicine wards (OR 1.26, 95 CI 1.00-1.61 and 2.02, 95% CI 1.33-3.06 respectively) (20).

Our study was not randomised such that it is possible that the improvement in HH compliance over time may have been influenced by other factors unrelated to study interventions. However, we conducted a separate QI project around the same time of conclusion of this study on another internal medicine ward which showed HSRs which were similar to pre-intervention (baseline) HSR on the ward where our study was performed.

In conclusion, our study showed that a combination of interventions involving ensuring availability of hand sanitisers as well as posting hand hygiene reminder notices significantly increased HSR from 24.8% to 50.6% (a 104% increase and a doubling from baseline rate) among medical teams in a resource limited setting but post-intervention rates are still sub-optimal. Post-contact HSR improved more than pre-contact HSR. Our study also showed that ensuring the availability and strategic placement of ABHRs

did not significantly impact HSRs.

Achieving optimal HH compliance remains elusive in low resource settings but represents the principal opportunity to significantly decrease the impact of HCAIs on patients and healthcare systems. Multimodal interventions are the best strategy and should be employed to achieve optimal hand hygiene adherence among HCWs. Studies evaluating strategies specifically targeting pre-contact HH compliance as well as addressing sustainability and maintenance of improved HH compliance rates in the long term are needed.

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REFERENCES

1. World Health Organization (WHO). WHO guidelines on hand hygiene in healthcare, 2009. http://whqlibdoc.who.int/publications/2009/9789241597906_eng.pdf. (accessed December 20, 2013).
2. Allegranzi B, Pittet D. Role of hand hygiene in healthcare-associated infection prevention. *J Hosp Infect*. 2009;**73**:305-315.
3. Ho ML, Seto WH, Wong LC, Wong TY. Effectiveness of multifaceted hand hygiene interventions in long-term care facilities in Hong Kong: a cluster-randomized controlled trial. I*nfect Control Hosp Epidemiol*. 2012; **33**:761-767.
4. Lam BC, Lee J, Lau YL. Hand hygiene practices in a neonatal intensive care unit: a multimodal intervention and impact on nosocomial infection. *Paediatrics*. 2004;**114**:565-571.
5. Shears P. Poverty and infection in the developing world: healthcare-related infections and infection control in the tropics. *J Hosp Infect*. 2007;**67**:217-224.
6. Suchomel M, Kundi M, Pittet D, Weinlich M, Rotter ML. Testing of the World Health Organization recommended formulations in their application as hygienic hand rubs and proposals for increased efficacy. *Am J Infect Control*. 2012;**40**:328-331.
7. Muto CA, Sistrom MG, Farr BM. Hand hygiene rates unaffected by installation of dispensers of a rapidly acting hand antiseptic. *Am J Infect Control*. 2000;**28**:273-276.
8. Boyce JM. Update on hand hygiene. *Am J Infect Control*. 2013;**41**:S94-96.
9. Y.C. Chen, W.H. Sheng, J.T. Wang, S.C. Chang, H.C. Lin, K.L. Tien *et al*. Effectiveness and limitations of hand hygiene promotion on decreasing healthcare-associated infections. *PLoS One*. 2011;**6**:e27163
10. Salama MF, Jamal WY, Mousa HA, Al-Abdulghani KA, Rotimi VO. The effect of hand hygiene compliance on hospital-acquired infections in an ICU setting in a Kuwaiti teaching hospital. *J Infect Public Health*. 2013;**6**:27-34.
11. Boyce JM, Pittet D. Guideline for Hand Hygiene in Health-Care Settings. Recommendations of the Healthcare Infection Control Practices Advisory Committee, Society for Healthcare Epidemiology of America, Association for Professionals in Infection Control and Infectious Diseases Society of America (HICPAC/SHEA/APIC/IDSA) Hand Hygiene Task Force. *MMWR Recomm Rep*. 2002;**51**:1-45.
12. Yawson AE, Hesse AA. Hand hygiene practices and resources in a teaching hospital in Ghana. *J Infect Dev Ctries*. 2013;**7**:338-347.
13. Harbarth S, Pittet D, Grady L, Zawacki A, Potter-Bynoe G, Samore MH *et al*. Interventional study to evaluate the impact of an alcohol-based hand gel in improving hand hygiene compliance. *Paediatr Infect Dis J*. 2002;**21**:489-495.
14. Voss A, Widemer, AF. No time for handwashing!? Handwashing versus alcoholic handrub: can we afford 100% compliance? *Infect Control Hosp Epidemiol*. 1997;**18**:205-8.
15. Pittet D, Hugonnet S, Harbarth S, Mourouga P, Sauvan V, Touveneau S *et al*. Effectiveness of a hospital- wide programme to improve improve compliance with hand hygiene. Infection Control Programme. *Lancet*. 2000;**356**:1307-1312.
16. Kukanich KS, Kaur R, Freeman LC, Powell DA. Evaluation of a hand hygiene campaign in outpatient healthcare clinics. *Am J Nurs*. 2013;**113**:36-42.
17. Fagernes M, Lingaas E. Impact of finger rings on transmission of bacteria during hand contact. *Infect Control Hosp Epidemiol*. 2009;**30**:427-432.
18. Uneke CJ, Ogbonna A, Oyibo PG, Onu CM. Bacterial contamination of stethoscopes used by health workers: public health implications. *J Infect Dev Ctries*. 2010;**4**:436-441.
19. McLaws ML, Pantle AC, Fitzpatrick KR, Hughes CF. Improvements in hand hygiene across New South Wales public hospitals: clean hands save lives, part III. *Med J Aust*. 2009;**191**:S18-24.
20. Pittet D, Mourouga P, Perneger TV. Compliance with handwashing in a teaching hospital. Infection Control Program. *Ann Intern Med*. 1999;**130**:126-30.