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An observational study of hand hygiene adherence following the introduction of an education intervention

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Abstract

Hand hygiene adherence needs to be increased and sustained in order to prevent and reduce healthcare associated infections. We implemented an educational intervention and observed the adherence of healthcare workers, patients and visitors over 24 hour periods at four observation points. For healthcare workers a total of 2,294 opportunities were observed and for patients and visitors, a total of 597 opportunities were observed. Healthcare worker adherence increased following the introduction of the educational intervention, with 53.0% (282/532) adherence at baseline (observation point 1), and was sustained varying between 67.7% and 70.8% in the post-intervention points ($p=0.0007$). The greatest increase in adherence was observed between baseline and the observation point 2. Adherence varied according to type of opportunity ($p<0.0001$) with the lowest level of adherence observed after contact with patient surroundings, however there was no obvious trend across the observation points. There was an interaction between point of study and ward ($p=0.0001$). For patients and visitors, adherence did differ according to the point of study ($p=0.0074$) with adherence prior to the intervention being 49.1% and then ranging from 43.5–61.8%. We suggest that future educational interventions should be implemented as this study implies that there is potential for increased and sustained adherence to hand hygiene protocols.

Introduction

Healthcare associated infections (HCAIs) are a concern for patients, healthcare workers (HCWs), healthcare providers and politicians (Hospital Infection Society/ICNA, 2007). The consistent application of infection prevention measures is essential and since Pittet et al's (2000) seminal piece of work where hand hygiene adherence increased following a multi-faceted campaign, hand hygiene has become a core component for reducing HCAIs. However despite an increased awareness and the implementation of a range of interventions, Higgins and Hannan (2013) conclude that the healthcare profession still struggles with hand hygiene adherence in the 21st century.

An inordinate amount of energy and resources have gone into improving hand hygiene adherence, with some success; intervention studies have reported sustained increases in adherence (Pittet et al, 2000; Huang et al, 2002; Huggonet et al, 2002; Randle et al, 2006; Higgins and Hannan, 2013) and a systematic review concluded that multifaceted approaches that provide education with written information, reminders and continuous performance feedback had been considered to be more effective than approaches involving a single type of intervention (Naikoba and Hayward, 2001). However, a more recent systematic review conducted by Gould et al (2007) concluded that there is little robust evidence to suggest that any interventions are effective in the long term.

Methods

Study design

This was an observational study of the hand hygiene adherence of HCWs, patients and visitors before and after the introduction of an educational intervention. The study was conducted over a nine month period at three monthly intervals in a large teaching hospital, where hand hygiene facilities and resources were available at the entrance and exit of all wards, at all sinks, patient bedsides and at regular points throughout the hospital.

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Development of the educational intervention

The multimedia intervention applied in this study was an educational video based on an e-learning format known as a reusable learning object (RLO) which was aimed at an individual learning experience. Numerous definitions for RLOs exist (Wiley, 2000; Duncan, 2003), but our definition is: 'an interactive, multimedia resource based on a single learning goal which can be used in multiple contexts'. Basically, RLOs are bite-sized chunks of e-learning, focusing on a specific topic and offering flexibility in their use. They are highly visual with an audio commentary and high quality graphics and typically they are 5–15 minutes of learning time. The ability to visualize processes as computerised animations or videos compared with trying to understand from static text appears to enhance learning and increases test scores. Reusable learning objects are both portable (and can be loaded onto virtual learning environments, websites, CDs or memory sticks) (Thatcher, 2006) and accessible because they are open educational resources (Windle et al, 2010) that do not require authentication to access them.

RLO development methodology

The development and quality assurance process have been described in detail elsewhere (Boyle et al, 2007). The evidence-based content for the RLOs was identified following a scoping process, which comprised a literature review to determine other educational resources such as leaflets that had been used to convey information about hand hygiene to patients and visitors and a number of scoping workshops involving infection control experts and academics. The output of this first scoping stage was a storyboard that was then distilled into a written specification. The specification was peer (quality) reviewed by two content experts (from the infection control unit at Nottingham University Hospitals NHS Trust) who also later reviewed (quality review 2) the prototype RLO following the media development stage. Following iterative review the RLO was ready for testing on the PatientLine server, which delivered the material to television monitors at the patient's bedside on the two wards participating in the study.

The educational video RLO called 'Clean your Hands' was delivered via a DVD on the PatientLine platform on hospital bedside monitors. Unless the monitors were switched off or patients were making telephone calls or accessing television, the videos were on display. This meant that people on the wards were receiving constant visual and auditory cues throughout the day and evening. At the end of the study a web-based version was developed and delivered as an open educational resource. This is freely available at http://www.nottingham.ac.uk/nmp/sonnet/rlos/placs/cleanyourhands. The RLO can also be accessed on mobile devices.

Study setting

The study was set on two wards (a 28-bed respiratory medicine ward and a 28-bed diabetic unit) which were randomly chosen. The data observation points were from 07.00hrs to 07.00hrs the next day and the observers stood in the same part of the ward, which allowed high levels of visual access to the majority of the clinical area. The wards were in close proximity, thus allowing time for data collection periods of 20 minutes, breaks and travel from ward to ward. In each hour, 20 minutes were spent observing on one ward, and then another 20 minutes observation was conducted on the other ward within the same hour slot. The observers were trained and had conducted pilot observation periods with members of the research team and a senior nurse within the infection prevention and control team. Different observers collected data over the duration of the study. The study was given permission to proceed by the local NHS ethics committee and Research and Development department. Before the study began, permission was secured from the clinical lead infection prevention and control in the trust and the nurse managers of the wards. Signs informing patients and visitors that an observational study was being conducted were placed at the wards' entrance explaining that if people did not wish to be observed they should contact the nurse in charge. No one asked to be excluded from data collection.

Data collection

Observations were conducted using a previously validated hand hygiene observation tool (McAteer et al, 2008). The inter-observer agreement of the observation tool had previously been established (interclass correlation coefficient=0.79) (McAteer et al, 2008). Within each 20 minute time period all opportunities observed were classified as one of five moments: before patient contact; before an aseptic task; after body fluid exposure risk; after patient contact; and after contact with patient surroundings. Each opportunity was then coded manually onto standardised sheets, as to whether the individual adhered (took the opportunity to wash her/his hands) or not. Participants were classified as: HCWs – doctors, nurses, allied healthcare professionals, ancillary and other staff; patients; or visitors. The data collection points were before the intervention (observation point 1 (opportunities=532) and at three separate observation points at three monthly intervals (observation point 2 (opportunities=402), observation point 3 (opportunities=706) and observation point 4 (opportunities=657)).

Data analysis

Separate analyses were conducted on opportunities presented to HCWs, and on opportunities presented to patients and visitors at each time point. Univariable logistic regression models were used to test the association across the four time points between the binary outcome variable of adherence (yes/no) and each of the exposures recorded were entered into the model as dummy variables. For HCWs, exposures were profession, ward, time of day (morning, afternoon, evening) and point of study. For patients and visitors the exposures were the same but with profession replaced with a binary variable to indicate whether the observed opportunity was presented to a patient or visitor. To adjust for potential confounding, multivariable logistic regression models were used to include all covariates that were statistically significant at the level of $p<0.05$. At this point interaction terms of covariate × time point were introduced to the relevant model to test whether change over time differed for individual levels of exposure variables. The model for healthcare workers included interaction terms of ward × time point and type of opportunity × time point and all exposures. For patients and visitors, we did not identify any associations between exposure and outcome other than time point so analyses did not extend beyond univariable models. Likelihood ratio tests were used to test for statistical significance. To account for dependency between observations taken on the HCW or patient or visitor, robust standard errors were used. Analysis was conducted in SPSS version 16 (SPSS Inc., Chicago, IL., USA) and Stata version 9 (Stata Corp., College Station, TX, USA).

Results

The hand hygiene adherence of HCWs, patients and visitors was monitored for 24 hours in the two wards at four points. Among HCWs, a total of 2,294 opportunities were observed across the four time points. Of these, 532 were observed prior to the intervention at point one, with the remainder observed after the introduction of the intervention at point two (n=402), point three (n=706) and point four (n=657) (Table 1). The proportion of opportunities taken by HCWs increased following the introduction of the educational package with 53.0% (282/532) adherence at baseline, and varying between 67.7% and 70.8% in the post-intervention points ($p<0.0001$).

After adjustment for all potentially explanatory factors and over all time periods, the probability of HCWs taking the hand hygiene opportunity did not vary by profession (p=0.11), ward (p=0.18), or time of day (p=0.13). Point of study remained positively associated after adjustment (p=0.0007) with greater adherence observed after baseline, and adherence varied according to type of opportunity ($p<0.0001$), with opportu-

Table 1. Level of adherence among sample of opportunities presented to healthcare workers at baseline and at three three-monthly points following the introduction of educational package

Variable	Proportion adhered (%)						
	Baseline (%)	Point 2	Point 3	Point 4	*p* for effect unadjusted	*p* for effect adjusted[a]	*p* for interaction with phase
Profession							
Doctor	50/89 (56.2)	52/78 (66.7)	25/42 (59.5)	38/81 (46.9)	<0.001	0.11	0.31
Nurse	212/394 (53.8)	149/206 (72.3)	267/392 (68.1)	214/286 (74.8)			
Allied health professional	6/11 (54.6)	37/49 (75.5)	149/213 (70.0)	170/219 (77.6)			
Ancillary and other staff	14/38 (36.8)	47/69 (68.1)	37/59 (62.7)	42/71 (59.2)			
Ward							
Diabetic unit	117/242 (48.4)	141/172 (82.0)	257/366 (70.2)	241/336 (71.7)	0.045	0.18	0.0001
Respiratory medicine	165/290 (56.9)	144/230 (62.6)	221/340 (65.0)	223/321 (69.5)			
Time of day							
Morning	86/168 (51.2)	99/141 (70.2)	138/225 (61.3)	151/241 (62.7)	0.004	0.13	0.49
Afternoon	100/173 (57.8)	96/131 (73.3)	176/264 (66.7)	153/213 (71.8)			
Night	96/191 (50.3)	90/130 (69.2)	164/217 (75.6)	160/203 (78.8)			
Type of opportunity							
Before patient contact	56/108 (51.9)	141/169 (83.4)	210/327 (64.2)	196/290 (67.6)	<0.0001	<0.0001	<0.0001
Before aseptic task	4/6 (66.7)	0/0	6/6 (100.0)	3/3 (100.0)			
After body fluid exposure	20/22 (90.9)	8/8 (100.0)	80/91 (87.9)	86/93 (92.5)			
After patient contact	78/93 (83.9)	102/143 (71.3)	145/217 (66.8)	114/142 (80.3)			
After contact with patient surroundings	124/303 (40.9)	33/81 (40.7)	37/65 (56.9)	65/129 (50.4)			
All opportunities	282/532 (53.0)	285/402 (70.8)	478/706 (67.7)	464/657 (70.6)	<0.0001	0.0007	

[a]Covariates in model: type of healthcare worker, ward, time of day and type of opportunity

Table 2. Odds ratios for opportunities presented to healthcare workers in final model

Variable	Adjusted odds ratio (95% CI)
Profession	
Doctor	1
Nurse	1.3 (1.04 to 1.86)
Allied health professional	1.52 (1.07 to 2.15)
Ancillary and other staff	1.17 (0.80 to 1.72)
Ward	
Respiratory medicine	
Baseline	1
Point 1	11.70 (5.82 to 23.54)
Point 2	2.26 (1.32 to 3.86)
Point 3	2.50 (1.45 to 4.32)
Diabetic unit	
Baseline	0.63 (0.43 to 0.92)
Point 1	7.34 (3.71 to 14.50)
Point 2	1.42 (0.85 to 2.37)
Point 3	1.57 (0.92 to 2.65)
Time of day	
Morning	1
Afternoon	1.23 (0.98 to 1.55)
Night	1.29 (1.02 to 1.64)
Type of opportunity[a]	
Before patient contact	
Baseline	1
Point 1	2.72 (1.47 to 5.04)
Point 2	1.17 (0.71 to 1.95)
Point 3	1.57 0.93 to 2.65)
After body fluid exposure	9.55 (2.12 to 42.97)
Baseline	25.97 (4.64 to 145.4)
Point 1	4.43 (2.01 to 9.76)
Point 2	1.75 (0.61 to 5.01)
Point 3	
After patient contact	5.32 (2.63 to 10.75)
Baseline	1.43 (0.80 to 2.55)
Point 1	1.38 (0.80 to 2.36)
Point 2	3.00 (1.61 to 5.60)
Point 3	
After contact with patient surroundings	0.65 (0.41 to 1.03)
Baseline	0.36 (0.19 to 0.70)
Point 1	0.97 (0.49 to 1.91)
Point 2	0.85 (0.47 to 1.52)
Point 3	

[a]Reference category is 'before patient contact' opportunity at baseline

nities less likely to be taken if it was 'after contact with patient surroundings'. The relationship between time (point of study) and adherence was not modified by profession (p=0.31) or time of day (p=0.49). We found evidence of an interaction between point of study and ward (p=0.0001), and point of study and type of opportunity (p<0.0001).

Odds ratios (OR) for HCWs for the final model including all explanatory covariates and interaction terms for point × ward and point × type of opportunity are reported in Table 2. Compared with the respiratory medicine ward at baseline, the odds of adherence was greater in both wards at point two, during the first set of observations after the introduction of the intervention. However, the increased odds was only observed in point two (OR 2.26, 95% confidence interval (CI) 1.32 to 3.86) and point three (OR 2.50, 95% CI 1.45 to 4.32) in the respiratory medicine ward and not in the diabetic unit. Compared to opportunities observed at baseline (point one), the odds of 'before patient contact' opportunities were greater at point two (OR 2.72, 95% CI 1.47 to 5.04) but not at point three or four. Although opportunities presented to HCWs 'after patient contact' or 'after contact with patient surroundings' were more likely to be taken than those 'before patient contact', there was no obvious relationship with point of study. Similarly, opportunities presented to HCWs 'after contact with patient surroundings' were less likely to be taken but there was no obvious trend across the four observation periods.

Table 3 reports the proportion of opportunities taken by patients and visitors at each time point and as these groups were transient then we can only report trends. A total of 597 hand hygiene opportunities were observed at each point, 228 to patients and 369 to visitors. Across all four points, there was no difference in the proportion of opportunities presented to non-staff between patients and visitors (p=0.21), the two wards (p=0.13), time of day (p=0.63), and type of

Table 3. Level of adherence among sample of opportunities presented to patients and visitors at baseline and at three three-monthly points following the introduction of educational package

Variable	Proportion adhered (%)				
	Baseline	Point 2	Point 3	Point 4	*p* for effect
Patients and visitors					0.21
Patients	2/10 (20.0)	8/10 (80.0)	78/133 (58.7)	42/75 (56.0)	
Visitors	51/99 (51.5)	52/128 (40.6)	37/53 (69.8)	51/89 (57.3)	
Ward					0.13
Diabetic unit	22/39 (56.4)	28/52 (53.9)	54/90 (60.0)	47/83 (56.6)	
Respiratory medicine	32/71 (45.1)	32/86 (37.21)	61/96 (63.5)	46/82 (56.1)	
Time of day					0.63
Morning	4/4 (100.0)	8/34 (23.5)	29/48 (60.4)	21/35 (60.0)	
Afternoon	50/100 (50.0)	39/77 (50.7)	64/100 (64.0)	55/100 (55.0)	
Night	0/6 (0.0)	13/27 (48.2)	22/38 (57.9)	16/29 (55.2)	
Type of opportunity					0.083
Before patient contact	30/54 (55.6)	33/70 (47.1)	36/51 (70.6)	26/48 (54.2)	
After body fluid exposure	0/1 (0.0)	4/4 (100.0)	24/42 (57.1)	27/40 (67.5)	
After patient contact	8/16 (50.0)	22/48 (45.8)	21/36 (58.3)	8/12 (66.7)	
After contact with patient surroundings	16/39 (41.0)	0/13 (0.0)	34/57 (59.7)	32/65 (49.2)	
All opportunities	54/110 (49.1)	60/138 (43.5)	115/186 (61.8)	93/165 (56.4)	0.0074

hand hygiene opportunity (p=0.083). The proportion of hand hygiene opportunities taken did differ according to point of study (p=0.0074), with opportunities presented to patients and visitors being taken 49.1% of the time prior to the intervention and 43.5%, 61.8%, and 56.4% at point two, point three and point four respectively.

Discussion

The purpose of this study was to observe hand hygiene adherence of HCWs, patients and visitors prior to and following the introduction of an educational intervention. The results show that HCWs' hand hygiene adherence improved immediately following the introduction of the educational intervention and was sustained at subsequent follow-up observation points. We note that a range of strategies were also introduced at a similar time, and factors such as the Health and Social Care Act and reducing rates of meticillin resistant *Staphylococcus aureus* (MRSA) and *Clostridium difficile* to meet national targets will also have affected adherence. We cannot therefore conclude that adherence increased and was sustained as a sole and direct result of the intervention. However, owing to the immediate improvement after its introduction its impact on improving and sustaining adherence should not be underestimated.

The recommendation that hand hygiene should become an education priority has already been established and policies have also emphasised the need for education and training for HCWs (Pittet et al, 2000) after indications that a lack of education and training increases non-adherence with the fundamentals of infection prevention and control practice (House of Lords Select Committee, 2002; National Audit Office, 2004).

All HCWs exceeded the reported norm of 39% (Allegranzi et al, 2011) and as discussion has ensued about what level adherence becomes sub-optimal, this is debated elsewhere (Cole, 2008). Visitors' adherence was just under the reported norm of HCWs and due to the paucity of research in this area and because they were a transient group, it is impossible to gain a clear picture or understanding of the hand hygiene behaviour of visitors. Therefore, although the role of the patient's hands in the transmission of HCAIs has often been overlooked (Randle et al, 2010), the reality is that patients and visitors have direct contact and also come into frequent contact with hand touch sites and are therefore at risk of transmitting pathogens. Lower levels of adherence were found across all groups for the moment 'after contact with patient surroundings'. The role of the environment in pathogenic cross-transmission has been debated, with Dancer (2009) long arguing that environmental cleaning needs to be improved generally and specifically at near touch sites. Hand hygiene has been described as a complex human behaviour that is composed in part of inherent practices which occur when an individual perceives their hands to be dirty (Porzig-Drummond et al, 2009) and when individuals touch things that do not appear visibly dirty such as contact after patient surroundings, they are less likely to clean their hands. Differences were found in the levels of adherence between the wards but as we did not measure other variables we cannot explain this difference. However, barriers to adherence have been identified (Pittet et al, 2000) which may explain the differences between the wards.

Recommendations have been made for more robust designs in hand hygiene studies (Gould et al, 2007) and as this was not a randomised controlled trial we cannot isolate the intervention from other factors. In this study, we conducted 24 hour observation of hand hygiene adherences over a nine month period which accounted for seasonal trends. We have already suggested that 24 hour observations are unjustifiable in terms of costs (Randle et al, 2010). At certain times over the 24 hour period, i.e. in the early hours of the morning, there was a minimum of participants to be observed and there may have been a Hawthorne effect of greater adherence as a result.

Conclusion

This study suggests that adherence can be improved and for the most part sustained by providing an individual learning experience that is accessible, visual and broken down into component parts.

Conflict of interest statement

None declared.

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References

Allegranzi B, Bagheri Nejad S, Combescure C, Graafmans W, Attar H, Donaldson L, Pittet D. (2011) Burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis *The Lancet* **377**(**9761**): 228–41.

Boyle T, Cook J, Windle R, Wharrad H, Leeder D, Alton R. (2007) Agile methods for developing learning objects. In *Proceedings of the 23rd Ascilite Conference*, Ireland.

Cole M. (2008) Adherence and infection control guidelines: a complex phenomenon. *British Journal of Nursing* **17**(**11**): 700–4.

Dancer S. (2009) The role of environmental cleaning in the control of hospital acquired infection. *Journal of Hospital Infection* **73**: 378–85.

Duncan C. (2003) Granularization. In LittleJohn A (Ed.), *Reusing online resources*. Kogan-Page: London: 12–19.

Gould D, Chudleigh JH, Moralejo D, Drey N. (2007) Interventions to improve hand hygiene adherence in patient care. *Cochrane Database of Systematic Reviews* **2**: CD005186.

Higgins A, Hannan M. (2013) Improved hand hygiene technique and compliance in healthcare workers using gaming technology. *Journal of Hospital Infection* **84**: 32–7.

Hospital Infection Society/Infection Control Nurses' Association. (2007) The third prevalence survey of healthcare associated infections in acute hospitals 2006. HIS/ICNA: London.

House of Lords Select Committee. (2002) *Fighting infection. 2002. Fourth Report*. Available from: www.parliament.uk (accessed 5 May 2013).

Huang J, Jiang D, Wang X, Liu Y, Fennie K, Burgess S, Williams A. (2002) Changing knowledge, behaviour and practice related to universal precautions among hospital nurses in China. *Journal of Continuing Education in Nursing* **33**(**5**): 217–24.

Hugonnet S, Perenger T, Pittet D. (2002). Alcohol-based hand rub improves adherence with hand hygiene in intensive care unit. *Archives of Internal Medicine* **162**(**9**): 1037–43.

McAteer J, Stone S, Fuller C. (2008) Development of an observational measure of healthcare worker hand-hygiene behaviour: the hand-hygiene observation tool (HHOT). *Journal of Hospital Infection* **68**(**3**): 222–9.

Naikoba S, Hayward A. (2001) The effectiveness of interventions aimed at increasing handwashing in healthcare workers – a systematic review. *Journal of Hospital Infection* **47**(**3**):173–80.

National Audit Office. (2004) *Improving patient care by reducing the risk of hospital acquired infection: a progress report*. The Stationery Office: London.

Pittet D, Hugonnet S, Harbarth S, Mourouga P, Sauvan V, Touveneau S, Perneger T. (2000) Effectiveness of a hospital-wide programme to improve adherence with hand hygiene. Infection control programme. *The Lancet* **356**(**9238**): 1307–12.

Porzig-Drummond R, Stevenson R, Case T, Oaten M. (2009) Can the emotion of disgust be harnessed to promote hand hygiene? Experimental and field-based tests. *Social Science Medicine* **68**(**6**): 1006–12.

Randle J, Clarke M, Storr J. (2006). Hand hygiene adherence in healthcare workers. *Journal of Hospital Infection* **64**(**3**): 205–9.

Randle J, Arthur T, Vaughan N. (2010) 24 hour observational study of hospital hand hygiene adherence. *Journal of Hospital Infection* **76**(**3**): 252–5.

Thatcher JD. (2006). Computer animation and improved student comprehension of basic science concepts. *Journal of the American Osteopathic Association* **106**(**1**): 9–14.

Wiley DA. (2000) Connecting learning objects to instructional design theory: a definition, a metaphor, and a taxonomy. In Wiley DA (Ed.), *The instructional use of learning objects*. Wiley: Bloomington. http://reusability.org/read/chapters/wiley.doc (accessed 13 May 2012).

Windle R, Wharrad HJ, McCormick D, Laverty H, Taylor M. (2010) Sharing and reuse in OER: experiences gained from open reusable learning objects in health. *Journal of Interactive Media in Education: JIME* http://jime.open.ac.uk/2010/04 (accessed 23 November 2011).