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ADHERENCE WITH UNIVERSAL PRECAUTIONS AFTER IMMEDIATE, PERSONALIZED PERFORMANCE FEEDBACK

MOLLI M. LUKE AND MARK ALAVOSIUS

UNIVERSITY OF NEVADA, RENO

We evaluated the effects of immediate, personalized performance feedback on adherence with hand hygiene by health-care staff in the context of a multiple baseline design across participants. Target behaviors reached mastery levels and were maintained near 100% throughout 2 months of maintenance probes.

Key words: adherence, feedback, hand sanitizing, hand washing

In 1987, the U.S. Centers for Disease Control and Prevention (CDC) introduced universal precautions (UP) for all health-care settings. The CDC initially designed UP in response to the human immunodeficiency virus (HIV) epidemic in an attempt to prevent patients with HIV from infecting other patients or health-care workers. Currently, the CDC defines UP as a set of precautions designed to prevent transmission of blood-borne pathogens when providing care. Boyce and Pittet (2002) suggested that UP were important to avoid health-care-associated infections, the spread of multiresistant organisms, and disease outbreaks. Hand hygiene (hand washing and hand sanitizing), an important component of UP, is recommended for a myriad of human service and health-care settings. Many studies performed in the past 10 to 15 years have reported that health-care workers adhere with hand-hygiene practices on average 40% of the time (see Pittet, 2000), although it is unclear how this reported hygiene adherence was determined because details were not provided. Most pathogens are spread in hospitals by the hands of health-care workers (Boyce, 2001). Kretzer and Larson (1998) described several theoretical frameworks that underlie intervention efforts, but few experimental studies have been conducted in the area of infection control in which variables are manipulated to determine functional relations.

In a notable exception, Stephens and Ludwig (2005) studied nurses' adherence to hand hygiene. Levels of adherence increased from 24% to 65% with an intervention package that included training discussions, goal setting, and individualized, graphic, publicly posted feedback. However, adherence decreased to 52% when the intervention was withdrawn. The purpose of the current study was to determine whether immediate performance feedback would increase and maintain adherence to hand hygiene by skilled health-care personnel.

METHOD

Participants and Setting

Three female health-care staff members (nurse practitioner, physician assistant, and medical assistant) participated in this study, which was conducted in the occupational health clinic of a community hospital. Typical services included lab work, check-ups, and physicals. Observations and feedback occurred in the clinic's four patient rooms and laboratory. Per hospital guidelines, patients provided verbal assent at the front desk prior to observers entering the treatment room to view patient care.

Response Measurement and Interobserver Agreement

The primary dependent variable, hand hygiene, included either hand washing or hand

Correspondence concerning this paper should be addressed to Molli M. Luke, Psychology Department, University of Nevada, Reno, Reno, Nevada 89557 (e-mail: molli.luke@gmail.com).

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Table 1
Average Percentage of Components of Hand Hygiene Completed Correctly

	Participant 1			Participant 2			Participant 3		
	BL	INT	MAIN	BL	INT	MAIN	BL	INT	MAIN
Hand washing									
Wet hands with water	47.2	100	100	42.9	71.4	100	100	94.7	100
Apply one full pump of soap	47.2	100	100	42.9	71.4	100	96.7	94.7	100
Hands wet before getting soap	0	87.9	100	40.5	71.4	100	23.3	78.9	80
Rub hands for at least 15 seconds	13.9	97	75	22.6	71.4	100	63.3	94.7	100
Soap covers backs of hands, palms, and wrists with hands below elbows	47.2	100	100	42.9	71.4	100	86.7	94.7	100
Rinse hands until all visible soap has been rinsed off	47.2	97	100	42.9	71.4	100	93.3	94.7	100
Dry hands with new paper towel	47.2	97	100	42.9	71.4	100	100	94.7	100
Use new paper towel to turn off faucet	0	93.9	100	38.1	71.4	100	3.3	84.2	90
Hand sanitizing									
Apply product to hand	0	100	100	0	100	100			
Rub hands together	0	100	100	0	100	100			
Cover all visible parts until dry	0	100	100	0	100	100			

sanitizing. Hand hygiene was operationally defined and task-analyzed into a recommended sequence of observable activities consistent with the CDC's definition for hand washing and hand sanitizing (Boyce & Pittet, 2002; see Table 1). The infection-control nurse verified the accuracy of the operational definitions and noted that all participants had completed the facility's infection-control training on correct hand hygiene. An observer followed each participant as she completed health-care routines with patients and used an observation checklist to score adherence with the recommended practices. The observer recorded the number of behaviors observed as well as the number of opportunities missed or incorrectly performed. Percentage adherence was calculated by dividing the number of components correctly completed by the number of opportunities for correct components. For instance, one occurrence of hand washing with all components correct except using a new paper towel to dry the hands produced 87.5% adherence (seven correct components divided by eight opportunities for correct components). Hand washing required more steps than hand sanitizing (eight vs. three; see Table 1). Either hand washing or hand sanitizing had to occur before contact with patient's skin, after contact with patient's skin, before donning gloves, after removing gloves, or after contact with inanimate objects in the immediate vicinity of the patient to be considered adherence to the operational definition. Thus, several opportunities to engage in hand-hygiene behavior were possible within a single observation of patient-care interaction. An average adherence score was calculated for each observation.

Two observers, naive to the purpose of the intervention, functioned as the primary data collectors during the patient-care interactions. Observers collected data simultaneously but independently during 21%, 42%, and 40% of the observations for Participants 1, 2, and 3, respectively. Interobserver agreement was defined as the same task component (e.g., "wet hands with water") scored in the same order by each observer. Agreement coefficients were calculated by dividing the number of agreements by the number of agreements plus disagreements and converting this ratio to a percentage. Mean interobserver agreement was 100%, 96% (range, 43% to 100%), and 100% for Participants 1, 2, and 3, respectively.

Procedure

Observers conducted routine observations throughout all phases of the experiment. During baseline, participants received no instruction or feedback. After baseline, the investigator provided individual, private, written and verbal feedback to each participant as soon as possible after observing contact with a patient. During all intervention observations, the investigator observed a participant interacting with a patient and scored adherence using a feedback form created from the observation checklist (as above). These observations lasted from a few minutes to an hour and occurred throughout the workday. Feedback was provided privately in the work environment after the first four (Participant 2) or five (Participants 1 and 3) observations and intermittently thereafter (Participants 1 and 2) until mastery criteria were met. The exact timing of feedback was dictated by the patient leaving the room, but feedback was always delivered within 30 s of the patient's exit. Thus, the time between the opportunities for correct hand hygiene and feedback varied. The feedback (both verbal and written) included statements describing what was done correctly, suggestions on how to improve adherence, showing the participant the feedback form, indicating which components were correct and incorrect, and describing the situations when the appropriate behaviors did or did not occur. Feedback lasted for approximately 1 to 2 min, and participants could ask questions and discuss the observation. Mastery criteria defined the termination of the intervention and were defined as five consecutive sessions at 100% adherence in the absence of the feedback source. Thus, mastery was detected by the primary observers and required sustained adherence when the investigator was absent. The investigator personally advised each participant on site when the feedback intervention ended. After each participant met the required 100% mastery criteria, follow-up observations probed for maintenance of adherence approximately 1 week, 2 weeks, 1 month, and 2 months after the feedback was terminated. A questionnaire was given at the end of the intervention to assess social (Wolf, 1978) and habilitative (Hawkins, 1991) validity and practicality of the intervention. The questionnaire addressed goals, procedures, and results of the study. Participants were given the anonymous questionnaire in an envelope and asked to place it in the investigator's mailbox.

Design

The effect of the independent variable was evaluated in a multiple baseline design across participants.

RESULTS AND DISCUSSION

Figure 1 depicts the percentage adherence for all three participants' hand-hygiene behavior across baseline, intervention, and maintenance. The time line of observations is depicted across actual work days on the *x* axis, and each data point represents a single observation. Depending on participants' work schedules and number of patients seen, there could be zero to 10 observations per day. Most of the errors observed during baseline were omitted components of the task analysis for hand washing (see Table 1). At times, participants did not wash their hands when they should have (e.g., before touching a patient). Anecdotally, participants reported that that they did not know how or when to wash their hands correctly; thus, the low adherence in baseline may have been due to lack of effective training. It is important to note that all participants had completed the hospital's infection-control training.

Participant 1's hygiene adherence averaged 44% in baseline, 87% during intervention, and 97% during maintenance. Participant 2's adherence averaged 57% during baseline, 86% during intervention, and 100% in maintenance. Participant 3's adherence was 59% in baseline, 95% during intervention, and 96% in maintenance. All participants reported that the program was worth the effort and agreed that the frequency

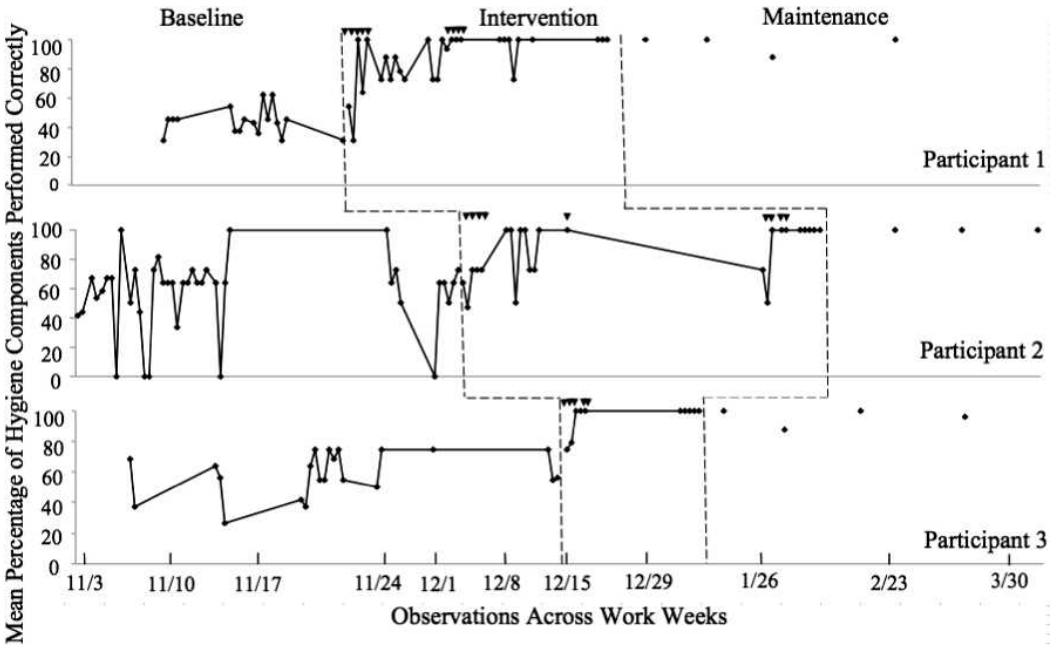

Figure 1. Mean percentage of hand hygiene components performed correctly across successive work weeks. Arrows indicate feedback given after that session by the investigator. All other data points represent observation without feedback.

and format of the feedback were helpful. The clinic director and infection-control nurse supported the program and requested a proposal to transfer the observation feedback system to internal managers in their organization.

In addition to being an effective intervention for other health-care-related behaviors (Alavoisus & Sulzer-Azaroff, 1986, 1990; Nyp et al., 2011), these results suggest that immediate, personalized feedback effectively increased and maintained improvements in hand hygiene. The increased levels and maintenance of adherence, in combination with the high user-satisfaction ratings, suggest that the current intervention may be effective for poor hand-hygiene practice. Creation of materials, observer training, observations, and feedback observations took approximately 250 hr over 6 months. This method was intensive to establish the intervention initially and ensure its efficacy, but replications and extensions would likely be less costly and time consuming.

The criteria for mastery (i.e., five consecutive sessions without feedback at 100% correct responding) ensured that the participants were exposed to a recent and extended history of correct responding. Training that concludes before learners demonstrate persistent habits (e.g., Stephens & Ludwig, 2005) appears to be insufficient to establish durable safety practices. Incomplete or faulty training, punishment for washing hands (e.g., dry cracked skin as a result of repeated washing), and few reinforcers delivered contingent on correct behavior may influence adherence levels. Training safety behaviors to high sustained rates appears to be effective in improving routine safety behaviors (e.g., Alavosius & Sulzer-Azaroff, 1986, 1990; the current study). In addition, this study provides details not available in the infection-control literature (e.g., Pittet, 2000) for collecting data on hand hygiene that can provide a way to calculate adherence rates systematically.

Some limitations warrant discussion. Participants were aware that observers were collecting data. After the first feedback session, the participants may have engaged in correct hand hygiene

due to reactivity. Future studies may assess reactivity to observers' presence (Kazdin, 1979) by systematically varying the participants' detection of data collection. To reduce reactivity, adherence might be measured via motion detectors at sinks, permanent products (e.g., amount of soap used), and hidden surveillance cameras. Second, although there was support for continuing and expanding the program in the clinic, the organizational supports needed for large-scale and prolonged operation of the program should be identified. Finally, participants maintained adherence for 2 months postfeedback. Determining how and when adherence may decline would better inform experimenters who schedule booster interventions to maintain treatment effects. Institutionalizing this method requires system-level analyses that will likely lead to technical innovations in work environments such that sustained adherence is the norm rather than the exception.

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