

Assessing Nurses' Hand Hygiene Practices by Direct Observation or Self-Report

Elaine L. Larson

Allison E. Aiello

Jeannie P. Cimiotti

*Columbia University School of Nursing
New York*

Methods of obtaining data on hand hygiene practices have not been well validated. The purpose of this study was to compare two methods of assessment of hand hygiene practices—direct observation and self-report using diaries. For 22 months, nursing staff ($n = 119$) from two neonatal ICUs recorded their hand hygiene practices on a diary card one shift/month ($n = 1,071$ diary cards). The same data were collected in monthly 1-hour direct observation sessions ($n = 206$ hours). Amount of time in gloves and total hand hygiene episodes/hour did not differ significantly by diary or observation, but four other specific parameters were significantly different. If hand hygiene practices are to be assessed over time, the same method must be used. Given these measurement limitations, more valid, practical, and less costly methods are needed.

Keywords: diaries; direct observation; hand hygiene; self-report; validity

The new CDC Hand Hygiene Guideline for Health Care Settings (Boyce & Pittet, 2002) recommends performance indicators for measuring improvements in health-care professionals' hand-hygiene adherence, including, for example, periodic monitoring of the number of hand-hygiene episodes performed by personnel and the number of hand hygiene opportunities, by ward or by service. Several difficulties arise with regard to assessing adherence to this guideline. It is not only costly and time consuming to conduct direct surveillance of individual practices but the observation itself is likely to change behavior. Further, methods of obtaining data on hand hygiene practices have not been well validated, that is, how accurate and reliable are intermittent observations, self-report, and other methods. The purpose of this study was to describe the hand hygiene practices of nurses working in two neonatal intensive care units (NICU) and to compare two methods of assessment of hand hygiene practices—direct observation and self-report using diaries.

Methods of Monitoring Hand Hygiene

Because hand hygiene is a primary prevention strategy for health care-associated infections, many studies have attempted to assess hand hygiene practices of health care personnel using a variety of methods. Such assessments are necessary for ongoing quality monitoring and also for evaluating the effectiveness of interventions to improve practice. The problem, however, is that each surveillance mechanism has limitations which com-

promise reliability and validity of the findings. Methods for monitoring hand hygiene behavior are discussed below and summarized in Table 1.

Direct Observation. The most frequently used surveillance method and the one most closely approaching a "gold standard" is direct observation, which has been conducted in either a clandestine fashion (Albert & Condie, 1981; Quraishi, McGuckin, & Blais, 1984; Tibballs, 1996) or openly (Earl, Jackson, & Rickman, 2001; Lankford et al., 2003; Lipsett & Swoboda, 2001; Meengs, Giles, Chisholm, Cordell, & Nelson, 1994; O'Boyle, Henly, & Larson, 2001; Salemi, Canola, & Eck, 2002). While observation provides the most direct measure of practice, it has two major disadvantages. First, it is extremely expensive, time consuming, and resource intensive. Second, there is evidence from studies conducted among the public that persons who know they are being observed change their behavior and are significantly more likely to wash (Munger & Harris, 1989; Pedersen, Keithly, & Brady, 1986). Clandestine observation, while having the advantage of minimal impact on behavior, raises ethical questions regarding informed consent for participants.

Self-Report. A second data collection method to measure hand hygiene practices is self-report in the form of interview or questionnaire (Harris et al., 2000; Nobile, Montuori, Diaco, & Villari, 2002; Zimakoff, Kjelsberg, Larsen, & Holstein, 1992) or, as in this current study, diary cards (Larson, Silberger, et al., 2000). In studies which have directly compared self-reported handwashing practices with direct observation, the correlations have been poor among health care personnel (Larson, McGinley, Grove, Leyden, & Talbot, 1986; O'Boyle et al., 2001) as well as those in the community (American Society for Microbiology, 2000; Manun'Ebo, Cousens, Haggerty, Kalengaie, Ashworth, & Kirkwood, 1997). For this study, we chose to use diary cards because they reduce the potential for recall bias and because we have used this method in previous studies of handwashing and found in random checks an acceptable level of adherence (Butz, Larson, Fosarelli, & Yolken, 1990; Larson, Aiello, Bastyr, et al., 2001; Larson, Silberger, et al., 2000; Larson et al., 1998). Others have reported good correlations between diary cards and recall (Nandha, Goodyer, & Woodruffe-Peacock, 2000) and successful use of diary cards with children (Butz & Alexander, 1991). A recent study, however, reported a high level of faked compliance when paper and electronic diary entries were compared (Stone, Shiffman, Schwartz, Broderick, & Hufford, 2003). Hence, while diaries may compare favorably with recall of information, they do not eliminate the potential for selective reporting on the part of the participant.

Video Monitoring. Three other data collection techniques have been reported in the literature. Video monitoring has been used to view hand hygiene behavior in several studies in intensive care units (Brown, Froese-Fretz, Luckey, & Todd, 1996; Nishimura, Kagehira, Kono, Nishimura, & Taenaka, 1999). This technique may be useful in settings in which a large space can be viewed at once, but raises concerns about privacy for patients and staff. Additionally, video monitoring may pose technical problems in a clinical setting.

Microbiological Methods. Microbiological methods such as impression plates have been suggested for assessing handwashing practices (Kaltenthaler & Pinfeld, 1995). Such methods may be appropriate for screening in community settings where hand hygiene is less frequent, but are not particularly useful in environments with higher levels of hygiene and in health care settings because there is insufficient pre-to-post hand hygiene variation among individuals with generally "cleaner" hands (Larson, Aiello, Lee, Della Latta, Gomez-Duarte, & Lin, 2003; Larson, Bobo, Bennett, Murphy, Seng, Choo, & Sisler, 1992).

TABLE 1. Methods to Assess Hand Hygiene Practices

	Method Examples	Advantages	Disadvantages
Observation Clandestine	(Albert & Condie, 1981; Bischoff Reynolds, Sessler, Edmond, & Wenzel, 2000; Tibballs, 1996)	Minimal effect on behavior, eliminates "Hawthorne effect"	Costly and time consuming; Ethical issues (i.e., lack of disclosure to "subjects")
Open	(Earl, Jackson, & Rickman, 2001; Lankford et al., 2003; Lipsett & Swobodo, 2001; Meengs, Giles, Chisholm, Cordell, & Nelson, 1994; Salemi, Canola, & Eck, 2002)	Most direct measure of behavior	Costly and time consuming; Results in behavior change
Self-report	(Butz et al., 1990; Harris et al., 2000; Larson et al., 2001; Manun'Ebo et al., 1997; Nobile et al., 2002; Zimakoff et al., 1992)	Inexpensive, efficient; possible to obtain a large sample size; reduce recall bias with diary format	Poor reliability and validity
Video monitoring	(Brown, Froese-Fretz, Luckey, & Todd, 1996; Nishimura, Kagehira, Kono, Nishimura, & Taenaka, 1999)	Less costly than direct observation; allows evaluation at any time	Low participant acceptability (e.g., privacy issues)
Microbiologic methods	(Kaltenhaler & Pinfold, 1995)	Helpful as visual teaching aid	Insufficient sensitivity to detect differences in relatively clean hands
Monitoring	(Bittner & Rich, 1998; Bittner, Rich, Turner, & Arnold, 2002; Kaltenthaler & Pinfold, 1995; Larson et al., 1991; Larson et al., 2000)	Measure highly correlated with hand hygiene practices; inexpensive and efficient	Measures overall volume of product use products, but not appropriateness of use; not possible to track specific individuals

Finally, in several studies product consumption has been monitored as an index of hand hygiene (Bittner & Rich, 1998; Bittner, Rich, Turner, & Arnold, 2002; Larson, McGeer, Quraishi, Krenzschek, Parsons, Holdford, & Hierholzer, 1991; Larson, Early, Cloonan, Sugrue, & Parides, 2000). Since the use of hand soap, alcohol hand rinses, lotions, and paper towels is highly correlated with hand hygiene practices, this method is potentially the most cost effective and accurate surveillance strategy, with the caveat that unit-specific product data must be available in a timely fashion so that it is possible to link practices in particular settings and during specific time periods with product consumption. As information systems in health care facilities improve, this strategy is very promising. A disadvantage of this monitoring method is that it precludes evaluation of individual behavior.

METHODS

Design

This study was an observational component of a larger NIH-funded clinical trial designed to assess the effects of two hand hygiene regimens on health care-associated infections in neonates. The data collection period was March 1, 2001, to January 31, 2003.

Sample and Setting

The study was conducted in two university-affiliated New York City Level III-IV NICU facilities: NICU 1 was a 44-bed NICU with an average of 16.0 nurses on staff per 12-hour shift; NICU 2 was a 50-bed NICU with an average of 15.5 nurses per 12-hour shift. Both units were part of the same health system and shared similar infection control policies and procedures and staff education. In both units, rooms held 3 to 14 isolettes and had 1 to 5 sinks. The sample population included 119 members of the nursing staff who were volunteer participants in this study: 61 nurses from NICU 1 (77% of total nursing staff) and 58 nurses from NICU 2 (75% of total nursing staff).

Procedures

The study was approved by the Institutional Review Board of each study institution and each nurse participant signed a written consent form. Two methods of data collection were used to assess hand hygiene practices: self-report diary cards and direct observation.

On a monthly basis, participating nurses were provided with a preprinted pocket-sized diary card on which they were instructed to prospectively record hand hygiene practices for one 12-hour shift. Data were recorded by making a "tick" each time they washed their hands, applied alcohol hand rinse or lotion, and donned gloves. They also recorded on the same card the approximate amount of time per hour spent wearing gloves. Each nurse was oriented individually to the recording requirements. Diary cards were delivered to and collected from each nurse by a member of the research team, who also monitored on a random basis adherence to the diary card completion.

Throughout the 22-month study, a trained member of the research team conducted monthly 1-hour observations of nurses at random intervals, using the same data collection instrument (the diary card) as the nurses used. Prior to initiating the observations, the interrater reliability between each team member was confirmed by simultaneous

observations conducted on the study units by several observers. This was repeated at intervals throughout the 2-year study, with the Project Director assessing agreement with all other data collectors. An agreement of > 95% on observed parameters was consistently obtained throughout the study.

During each observation period, a different room of the NICU was systematically selected, the observer stood in the room, and the hand hygiene practices for each nurse working in that room were recorded. If there was little activity in the selected room, or if a clinical situation made it difficult or inconvenient to conduct observations, the observer went to the next room. The same data were collected by observation as by diary cards, that is, number of handwashes, applications of alcohol hand rinse or lotion, number of glovings, and approximate amount of time/hour spent wearing gloves. No attempt was made to mask the observations, and staff members were aware of the presence of the observer. Because individual staff members were not identified on the data collection forms (neither the self-report diary cards nor the direct observations), it was not possible to link a diary cards and observational data to any specific nurse.

Data Analysis

Numbers of handwashes and alcohol hand rinse applications were calculated separately and then a variable, total hand hygiene episodes, was created by summing both washes and alcohol applications. Means and 95% confidence limits were calculated for each hand hygiene practice as obtained from either the diary cards or the observations. These means were then compared by calculating an effect size (i.e., the amount of variation between the scores obtained by each method) to examine the absolute differences between diary cards and observation, using the following formula: mean score by diary - mean score by observation/pooled standard deviation. Finally, the nonparametric Mann-Whitney test was used to compare six practices (number handwashes, alcohol applications, lotion applications, glovings/hour, total minutes in gloves/hour, and total number of hand hygiene episodes/hour) between NICU 1 and NICU 2 as reported by both diary cards and observation.

RESULTS

There were 1,071 diary cards submitted by 106 nurses over the study period, an average of 10.1 submissions/nurse (range: 1 to 23) and 206 hours of observation during the study. None of the hand hygiene practices were significantly different between the two units by observation, but all six practices were significantly different between NICU 1 and 2 as reported by the diary cards (see Table 2).

Mean and 95% confidence limits for the six hand hygiene practices as recorded by nurse self-report or by direct observation are summarized and compared on Table 3. Those practices for which the confidence limits did not overlap (i.e., yielded significantly different results by the two methods) included the number of handwashes, alcohol applications, lotion applications, and glovings/hour. The minutes/hour in gloves and the total hand hygiene episodes/hour were not statistically significantly different by diary or observation. The number of glovings/hour were more than double by observation than by diary cards. Other effect sizes (i.e., the absolute difference between the two measurement methods), however, were small, between 0.1 and 0.4.

TABLE 2. Hand Hygiene Practices by NICU as Reported by Self-Report Diary Cards and Direct Observation

Data Source	Practice	Mean/Hour		p Value*
		NICU 1	NICU 2	
Diary Card	# handwashes	1.59	1.21	0.000
	# alcohol applications	1.68	1.61	0.02
	# lotion applications	0.46	0.57	0.003
	# glovings	1.42	0.97	0.000
	Minutes in gloves	19.3	11.5	0.000
	Total hand hygiene episodes*	2.28	2.24	0.002
Observation	# handwashes	1.83	1.83	0.87
	# alcohol applications	0.95	1.10	0.07
	# lotion applications	0.07	0.18	0.23
	# glovings	2.58	2.59	0.57
	Minutes in gloves	17.35	16.96	0.97
	Total hand hygiene episodes**	2.49	2.62	0.32

*Mann-Whitney test comparing means of NICU 1 and 2.

**Total mean hand hygiene episodes/hour = # handwashes/hour + # alcohol applications/hour.

TABLE 3. Comparison of Nurses' Self-Report and Observer Report of Hand Hygiene Practices in Two NICUs (N = 119)

Practice	Mean (95% Confidence Limits)		Effect Size*
	Diary Cards (n = 1,071)	Direct Observation (n = 206 hours)	
# handwashes/hour	1.24 (1.09–1.38)	1.86 (1.62–2.10)	0.42
# alcohol applications/hour	1.55 (1.40–1.70)	0.98 (.67–1.28)	0.38
# lotion applications/hour	0.51 (.45–.58)	0.10 (.03–.18)	0.82
# glovings/hour	1.21 (1.02–1.23)	2.65 (2.40–2.90)	1.26
Mins/hour in gloves	15.9 (14.2–17.6)	17.1 (15.3–19.0)	0.1
Total hand hygiene episodes/hour	2.26 (2.17–2.35)	2.54 (2.26–2.82)	0.19

*Effect size = Absolute difference between the two measurements (mean of diary - mean of observation/pooled standard deviation).

DISCUSSION

Limitations

In our study, consistent with other literature (American Microbiology, 2000; Manun'Ebo et al., 1997; O'Boyle et al., 2001) there were major differences between self-report and observational data in hand hygiene practices, but we are unable to confirm which data collection strategy was more accurate or less biased. It is possible, for example, that the short observation periods, an hour in length and often during the day shift, were not sufficiently representative of the entire time period being studied. Further, because observations were done without identification of individuals, we were unable to correlate individual self-report and

observed behavior as was done by O'Boyle and colleagues (2001). If there was bias present in the data, the direction of the bias cannot be estimated either since there was no identifiable trend of underreporting or overreporting with one of the methods as compared with the other.

Implications

We conclude that methods used to monitor adherence to hand hygiene guidelines will have a substantive impact on the results obtained. Although most of the hand hygiene practices studied were significantly different by self-report and observation, the absolute differences between the two methods (effect size) were relatively small. Hence, it would still be possible to assess practice changes before and after interventions or over time as long as any systematic bias present is similar across time and in various groups or settings and as long as the same method of assessment is used over time. Nevertheless, given these measurement limitations, it may be undesirable to continue to collect hand hygiene data by direct observation because of the likelihood that those being observed will modify their behavior and because this method is extremely costly and invasive. Since CDC's Hand Hygiene Guideline recommends ongoing monitoring of adherence to recommended practices, more valid, practical, and less costly methods are needed. Monitoring product use may be the most feasible option for the majority of health care institutions at this time.

REFERENCES

- Albert, R. K., & Condie, F. (1981). Hand-washing patterns in medical intensive-care units. *New England Journal of Medicine*, 304(24), 1465-1466.
- American Society for Microbiology. (2000). *Clean Hands Campaign*. American Society for Microbiology, Washington, DC. Retrieved January 26, 2005, from <http://www.washup.org/page01.htm>
- Bischoff, W. E., Reynolds, T. M., Sessler, C. N., Edmond, M. B., & Wenzel, R. P. (2000). Handwashing compliance by health care workers: The impact of introducing an accessible, alcohol-based hand antiseptic. *Archives of Internal Medicine*, 160(7), 1017-1021.
- Bittner, M. J., & Rich, E. C. (1998). Surveillance of handwashing episodes in adult intensive-care units by measuring an index of soap and paper towel consumption. *Clinical Performance Quality Health Care*, 6(4), 179-182.
- Bittner, M. J., Rich, E. C., Turner, P. D., & Arnold, W. H., Jr. (2002). Limited impact of sustained simple feedback based on soap and paper towel consumption on the frequency of hand washing in an adult intensive care unit. *Infection Control and Hospital Epidemiology*, 23(3), 120-126.
- Boyce, J. M., & Pittet, D. (2002). 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. *American Journal of Infection Control*, 30(8), S1-46.
- Brown, J., Froese-Fretz, A., Luckey, D., & Todd, J. K. (1996). High rate of hand contamination and low rate of hand washing before infant contact in a neonatal intensive care unit. *Pediatric Infectious Disease Journal*, 15(10), 908-910.
- Butz, A. M., & Alexander, C. (1991). Use of health diaries with children. *Nursing Research*, 40(1), 59-61.
- Butz, A. M., Larson, E., Fosarelli, P., & Yolken, R. (1990). Occurrence of infectious symptoms in children in day care homes. *American Journal of Infection Control*, 18(6), 347-353.
- Earl, M. L., Jackson, M. M., & Rickman, L. S. (2001). Improved rates of compliance with hand antiseptics guidelines: A three-phase observational study. *American Journal of Nursing*, 101(3), 26-33.
- Harris, A. D., Samore, M. H., Nafziger, R., DiRosario, K., Roghmann, M. C., & Carmeli, Y. (2000). A survey on handwashing practices and opinions of healthcare workers. *Journal of Hospital Infections*, 45(4), 318-321.

- Kaltenthaler, E. C., & Pinfold, J. V. (1995). Microbiological methods for assessing handwashing practice in hygiene behaviour studies. *Journal of Tropical Medicine Hygiene*, 98(2), 101-106.
- Lankford, M. G., Zembower, T. R., Trick, W. E., Hacek, D. M., Noskin, G. A., & Peterson, L. R. (2003). Influence of role models and hospital design on hand hygiene of healthcare workers. *Emerging Infectious Disease*, 9(2), 217-223.
- Larson, E., Aiello, A., Heilman, J., Lyle, C., Cronquist, A., Stahl, J., & Della-Latta, P. (2001). Comparison of different regimens for surgical hand preparation. *AORN Journal*, 73, 412-432.
- Larson, E., Aiello, A., Lee, L., Della-Latta, P., Gomez-Duarte, C., & Lin, S. (2003). Short- and long-term effects of handwashing with antimicrobial or plain soap in the community. *Journal of Community Health*, 28, 139-150.
- Larson, E., Bobo, L., Bennett, R., Murphy, S., Seng, S. T., Choo, J. T., & Sisler, J. (1992). Lack of care giver hand contamination with endemic bacterial pathogens in a nursing home. *American Journal of Infection Control*, 20(1), 11-15.
- Larson, E., McGeer, A., Quraishi, Z. A., Krenzischek, D., Parsons, B. J., Holdford, J., et al., (1991). Effects of an automated sink on handwashing practices and attitudes in high-risk units. *Infection Control and Hospital Epidemiology*, 12, 422-428.
- Larson, E., Silberger, M., Jakob, K., Whittier, S., Lai, L., Della Latta, P., & Saiman, L. (2000). Assessment of alternative hand hygiene regimens to improve skin health among neonatal intensive care unit nurses. *Heart and Lung*, 29(2), 136-142.
- Larson, E. L., Aiello, A. E., Bastyr, J., Lyle, C., Stahl, J., Cronquist, A., Lai, L., & Della-Latta, P. (2001). Assessment of two hand hygiene regimens for intensive care unit personnel. *Critical Care Medicine*, 29(5), 944-951.
- Larson, E. L., Early, E., Cloonan, P., Sugrue, S., & Parides, M. (2000). An organizational climate intervention associated with increased handwashing and decreased nosocomial infections. *Behavioural Medicine*, 26(1), 14-22.
- Larson, E. L., Hughes, C. A. N., Pyrek, J. D., Sparks, S. M., Cagatay, E. U., & Bartkus, J. M. (1998). Changes in bacterial flora associated with skin damage on hands of health care personnel. *American Journal of Infection Control*, 26, 513-522.
- Larson, E. L., McGinley, K., Grove, G., Leyden, J. J., & Talbot, G. (1986). Physiologic, microbiologic and seasonal effects of handwashing on the skin of health care personnel. *American Journal of Infection Control*, 14, 51-59.
- Lipsett, P. A., & Swoboda, S. M. (2001). Handwashing compliance depends on professional status. *Surgical Infections*, 2(3), 241-245.
- Manun'Ebo, M., Cousens, S., Haggerty, P., Kalengaie, M., Ashworth, A., & Kirkwood, B. (1997). Measuring hygiene practices: A comparison of questionnaires with direct observations in rural Zaire. *Tropical Medicine and International Health*, 2(11), 1015-1021.
- Meengs, M. R., Giles, B. K., Chisholm, C. D., Cordell, W. H., & Nelson, D. R. (1994). Hand washing frequency in an emergency department. *Annals of Emergency Medicine*, 23(6), 1307-1312.
- Munger, K., & Harris, S. (1989). Effects of an observer on handwashing in public restroom. *Perceptual and Motor Skills*, 69(3), 733-734.
- Nandha, D., Goodyer, L., & Woodruffe-Peacock, C. (2000). Diary cards and the assessment of cough symptoms in community pharmacies. *Pharmacy World Science*, 22(1), 17-20.
- Nishimura, S., Kagehira, M., Kono, F., Nishimura, M., & Taenaka, N. (1999). Handwashing before entering the intensive care unit: What we learned from continuous video-camera surveillance. *American Journal of Infection Control*, 27(4), 367-369.
- Nobile, C. G., Montuori, P., Diaco, E., & Villari, P. (2002). Healthcare personnel and hand decontamination in intensive care units: Knowledge, attitudes, and behaviour in Italy. *Journal of Hospital Infection*, 51(3), 226-232.
- O'Boyle C, A., Henly, S. J., & Larson, E. (2001). Understanding adherence to hand hygiene recommendations: The theory of planned behavior. *American Journal of Infection Control*, 29(6), 352-360.
- Pedersen, D. M., Keithly, S., & Brady, K. (1986). Effects of an observer on conformity to handwashing norm. *Perceptual and Motor Skills*, 62(1), 169-170.
- Quraishi, Z. A., McGuckin, M., & Blais, F. X. (1984). Duration of handwashing in intensive care units: A descriptive study. *American Journal of Infection Control*, 12(2), 83-87.
- Salemi, C., Canola, M. T., & Eck, E. K. (2002). Hand washing and physicians: How to get them together. *Infection Control and Hospital Epidemiology*, 23(1), 32-35.

- Stone, A. A., Shiffman, S., Schwartz, J. E., Broderick, J. E., & Hufford, M. R. (2003). Patient compliance with paper and electronic diaries. *Controlled and Clinical Trials, 24*(2), 182-199.
- Tibballs, J. (1996). Teaching hospital medical staff to handwash. *Medical Journal of Australia, 164*(7), 395-398.
- Zimakoff, J., Kjelsberg, A. B., Larsen, S. O., & Holstein, B. (1992). A multicenter questionnaire investigation of attitudes toward hand hygiene, assessed by the staff in fifteen hospitals in Denmark and Norway. *American Journal of Infection Control, 20*(2), 58-64.

Acknowledgments. This study was funded by a grant from the National Institute for Nursing Research, National Institutes of Health, "Staff Hand Hygiene and Nosocomial Infection in Neonates," 1 R01 NR05197-01A1. The authors gratefully acknowledge their research team, particularly Drs. Mirjana Nesin, Lisa Saiman, and Pablo San Gabriel, Ms. Janet Haas, Christopher Chantler, and Pamela Cook.

Offprints. Requests for offprints should be directed to Elaine Larson, RN, PhD, FAAN, CIC, Columbia University School of Nursing, 630 W. 168th St., New York, NY 10032. E-mail: ELL23@columbia.edu