Hand hygiene in pediatric and neonatal intensive care unit patients: Daily opportunities and indication- and profession-specific analyses of compliance

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Background: Hand hygiene is considered to be the single most effective tool to prevent health care-associated infections. Daily hand hygiene opportunities and compliance for pediatric/neonatal intensive care units (ICU) are currently unknown.
Methods: This was a prospective observational study in pediatric and neonatal ICU patients with analyses of hand hygiene behavior in relation to profession, indication, and shift and correlation with disinfectant usage.
Results: Hand hygiene opportunities were significantly higher for pediatric (321/24 hours) than neonatal (194/24 hours; $P = .024$) patients. Observed compliance rates were 53% (pediatric) and 61% (neonatal) and found to be significantly higher in nurses (57%; 66%) than in physicians (29%, 52%, respectively; $P < .001$; $P = .017$, respectively). For neonates, compliance rates were significantly higher before patient contact and aseptic tasks (78%) than after patient, patient body fluid, or patients' surrounding contact (57%; $P < .001$). Calculating disinfectant usage revealed a 3-fold lower compliance rate of 17%.
Conclusion: This study provides the first data on opportunities for and compliance with hand hygiene in pediatric/neonatal patients encompassing the whole day and night activities and including a comparison of observed and calculated compliance rates. Observation revealed high compliance especially in nurses and in situations of greatest impact. The data provide a detailed characterization of hand hygiene performance in the neonatal/pediatric ICU setting.
Key Words: Infection control; hand hygiene; neonatology; pediatrics; intensive care unit.

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Health care-associated infections have a great impact on morbidity, mortality, length of hospital stay, and costs.[1-5] Intensive care units (ICUs) represent a center of health care-associated infections because of patients' characteristics.[2,4-8] Particularly, the use of various invasive devices is one of the most important risk factors for acquiring health care-associated infections.[7,8] Moreover, these infections play an even more important role in neonates.[9] Hand hygiene is regarded as the most effective single measure to prevent health care-associated infections and was shown to reduce transmission of pathogenic microorganisms.[10-14] Contaminated health care workers' hands were clearly related to outbreaks[15] including neonates.[16] Although there are several recommendations and general investigation on hand hygiene,[10,11,17] compliance rates are approximately 40%.[18,19] Average number of daily opportunities for hand disinfection have been defined for different ICUs caring for adults.[20] The number of daily hand hygiene opportunities for neonatal and pediatric ICU patients has yet to be defined. In addition, importantly, neonates represent a highly specific

patient population, raising the question of the best way to adopt the general World Health Organization (WHO) recommendations on hand hygiene. Moreover, because of the special responsibility of nurses caring for neonates and pediatric patients, results from adult ICUs may not be easily transferable. Finally, compliance rates for neonatal and pediatric ICUs encompassing whole workday activities are lacking. Direct observation is assumed to be the gold standard for defining compliance rates,[21] but previous investigations have shown considerable differences to that calculated by disinfectant usage.[20] Gould et al[22] and van de Mortel et al[23] strongly suggest at least to combine direct observation with disinfectant usage to analyze compliance.

Thus, the aim of this study was to define hand hygiene opportunities, as well as patient-, indication-, and profession-specific compliance rates encompassing complete day and night activities. Moreover, we compared observed and calculated compliance rates. Therefore, we conducted a prospective observational study on a neonatal and pediatric ICU.

METHODS

Hospital setting

This study was performed at the University Hospital Aachen, a tertiary care center, in 2009. A pediatric and neonatal ICU with 19 beds participated. Written protocols on hand hygiene had been implemented, trainings on hand hygiene had been carried out on a regular basis, and the equipment with disinfectant dispensers was sufficient.

Patients

Patients were divided into 2 groups: The pediatric ICU (PICU) patient group consisting of PICU patients with a high number of post open heart surgery patients and non-surgical, critically ill patients. The neonatal ICU (NICU) patient group consisted of neonates only cared for within an incubator. The patient-day ratio of PICU and NICU patients was approximately 1:1 in 2009. Observation on all patients was carried out pseudonymously; the following data on patients were documented: age, weight, number and type of invasive devices, number of daily feedings in NICU patients (Table 1).

Table 1. Patients' characteristics

	PICU (n = 49)	NICU (n = 50)
Age (range)	11 (1-17) yr	27 (1-101) days
Weight (g; SD)	–	1,566 (±642)
Date of birth	–	
Week of gestation		29 + 2
Weight (g; SD)		1,328 (±783)
Presence of the following (%)		
Peripheral venous catheter	78	56
Central venous catheter	94	10
Tracheal tube	37	0
CPAP mask	0	61
Stomach tube	26	78
Stoma	0	20
Urinary tract catheter	92	0
No. of feedings/24 h	–	10 (+3)

CPAP, continuous positive airway pressure; *NICU*, neonatal intensive care unit; *PICU*, pediatric intensive care unit; *SD*, standard deviation.

Direct observation

Direct observation was carried out patient directed by 1 observer only for each 96 hours in the PICU and the NICU patient groups. Observation periods were distributed equally over the day (0:00-24:00); the observation time was distributed to 96 observation periods each lasting 2 hours to avoid fatigue. To avoid misreporting, no more than 2 patients were observed simultaneously, and this only applied to close proximity patients. Hand hygiene opportunities and hand hygiene activities were documented on a standardized observation record (Appendix 1). The observation was announced and carried out in collaboration with the department of pediatrics and neonatology. Before beginning, a 6-week pilot observation phase was implemented for familiarization with the situation of being the observed group. Additionally, the general recommendations for hand hygiene were adopted to the precise demands for the special patient groups. Therefore, all activities representing an opportunity for hand hygiene were classified into 5 indication categories according to the WHO guidelines:[10,17] (1) before patient contact, (2) before aseptic task, (3) after body fluid exposure, (4) after patient contact, and (5) after contact with patient's surroundings. Opportunities such as patient contacts as well as patient-associated procedures such as preparation of intravenous medication and waste disposal were reported. To avoid misreporting, no more than 2 patients were observed simultaneously, and this only applied to nearby patients. By overlap of 2 indications representing 1 opportunity (eg, 3 followed by 2), both were documented indication specifically but counted only as 1 opportunity. Compliance rates (%) were analyzed on the level of the patient group (PICU/NICU), professions (ward-associated nurses, ward-associated physicians, and others), indications (indication 1-5), and shifts (early shift [ES]: 06:00-14:00; late shift [LS]: 14:00-22:00; night shift [NS]: 22:00-06:00). Glove use instead of hand disinfection was calculated as glove use divided by the number of hand hygiene opportunities without hand disinfection.