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Contact Precautions for Multidrug-Resistant Organisms (MDROs): Current Recommendations and Actual Practice

Sarah A. Clock¹, Bevin Cohen¹, Maryam Behta², Barbara Ross³, and Elaine L. Larson^{1,*}

¹Center for Interdisciplinary Research to Reduce Antimicrobial Resistance (CIRAR), School of Nursing, Columbia University, New York, New York

²Department of Information Services, New York-Presbyterian Hospital, New York, New York

³New York-Presbyterian Hospital, Weill-Cornell Medical Center Department of Epidemiology, New York, New York

Abstract

Background—Contact precautions are recommended for interactions with patients colonized/infected with multidrug-resistant organisms; however, rates of contact precautions practice are unknown.

Methods—Observers recorded the availability of supplies and staff/visitor adherence to contact precautions at rooms of patients indicated for contact precautions. Data were collected at three sites in a New York City hospital network.

Results—Contact precautions signs were present for 85.4% of indicated patients. The largest proportions were indicated for isolation for vancomycin-resistant enterococci and methicillin-resistant *Staphylococcus aureus* cultures. Isolation carts were available outside 93.7–96.7% of rooms displaying signs, and personal protective equipment was available at rates of 49.4–72.1% for gloves (all sizes: small, medium, and large) and 91.7–95.2% for gowns. Overall adherence rates upon room entry and exit, respectively, were 19.4% and 48.4% for hand hygiene, 67.5% and 63.5% for gloves, and 67.9% and 77.1% for gowns. Adherence was significantly better in intensive care units ($p < 0.05$) and by patient-care staff ($p < 0.05$), and patient-care staff compliance with one contact precautions behavior was predictive of adherence to additional behaviors ($p < 0.001$).

Conclusions—Our findings support the recommendation that methods to monitor contact precautions and identify and correct non-adherent practices should be a standard component of infection prevention and control programs.

Keywords

Contact Precautions; Adherence; Isolation; Antimicrobial Resistance; Compliance

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*Correspondence to: Elaine L. Larson, Columbia University School of Nursing, 630 W. 168th St., New York, NY 10032, Phone: 212-305-0723, FAX: 212-305-0722, ell23@columbia.edu

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INTRODUCTION

Antimicrobial-resistant healthcare-associated infections are a significant cause of morbidity, mortality and excess cost, and there is ample evidence that the prevalence of multidrug resistance is increasing in many organisms (1-3). To prevent transmission of multidrug-resistant organisms (MDROs), the Centers for Disease Control and Prevention's Healthcare Infection Control Advisory Committee (HICPAC) advocates initiating contact precautions—a protocol that provides guidance on the use of hand hygiene and barrier precautions for contact with patients colonized/infected with MDROs or their environments (4,5). The HICPAC guidelines are based on efficacy studies demonstrating infection control using barrier precautions, but adherence to these behaviors in practice has not been fully evaluated.

An institution's ability to control MDRO spread using contact precautions is likely influenced by timely identification of colonized/infected patients and initiation of precautions, communication of precaution requirements to staff/visitors, and staff/visitor adherence to the protocol. Implementing these steps is challenging for many institutions. We conducted an observational study on adherence to contact precautions prior to interventions planned by the institution's infection prevention and control program, including the implementation of an electronic surveillance system. This study's aims were to assess (1) the proportion of patients indicated by positive culture for which contact precautions were initiated; (2) the availability of contact precautions equipment; (3) adherence to the contact precautions protocol by staff/visitors; and (4) differences in adherence to contact precautions by hospital, unit type, unit policy, and MDRO.

METHODS

Sample and Setting

This study was conducted at three sites within the New York-Presbyterian Hospital system in New York City: (1) a 221-bed adult community hospital; (2) a 283-bed children's academic acute-care facility; and (3) a 692-bed adult academic tertiary-care facility. All inpatient units were included, except psychiatric and maternity wards. The Columbia University Medical Center institutional review board approved this study.

Instrument and Procedure—The study institution requires a hospital-issued contact precautions sign outside rooms of indicated patients and practice of the following precautions by staff/visitors: hand hygiene and donning of gown and gloves immediately prior to room entry, and disposal of gown and gloves inside the patient's room, followed by hand hygiene, immediately prior to room exit.

Each day, one of two trained observers generated an electronic report, which listed patients indicated for contact precautions based on positive microbiology culture for an epidemiologically-significant organism, either *Clostridium difficile* or a drug-resistant organism, collectively referred to as MDROs in this study. The report contained patients' names, medical record numbers, current room numbers, and MDRO cultures. Using a standardized form, observers recorded the availability of contact precautions equipment and staff/visitor adherence to contact precautions for patient rooms listed on the report and for rooms displaying a contact precautions sign for other clinical indications (e.g., unit policy or MDRO information from other institutions).

The presence/absence of a contact precautions sign was recorded for each room. Rooms displaying a sign were evaluated for presence of an isolation cart and gloves (all sizes: small, medium, large) and gowns on the cart. Staff/visitors entering these rooms were observed for hand hygiene performance and donning gloves and gown upon entry; those exiting were

observed for disposal of gloves and gown inside the room and subsequent hand hygiene performance. Staff were recorded as patient-care or other staff (i.e., cleaning and food-service staff). Additionally, observers noted the location of barrier disposal containers (i.e., ones located outside patient rooms); whether visitors observed inside isolation rooms, but not entering or exiting, wore gowns; and instances of “environmental contamination” when staff/visitors potentially contaminated objects/surfaces outside isolation rooms (e.g., by touching items outside the room with gloves previously worn inside the room). Observations were conducted in four 5-day increments at each of the sites, totaling 60 days, from April-June 2008. Data were archived in Excel (Microsoft Corporation, Office 2003, Redmond, WA).

Before the study commenced, pilot data were collected by three observers to ensure systematic recording of observations and inter-rater reliability. The following decision rules were agreed upon, and an inter-rater reliability >95% was confirmed prior to data collection: (1) Data elements not observed directly were considered incomplete information and not included in the evaluation. (2) Patient location was confirmed with unit clerks for rooms on the report that did not display a sign. (3) For isolation rooms with dedicated anterooms or cabinets for contact precautions supplies, the isolation cart was considered “not applicable.” (4) Gloves and gowns were considered present if on/in the isolation cart or mounted outside the room. (5) Staff/visitor adherence was not recorded if the subject did not touch anything while inside the room. (6) If staff/visitors wore a barrier in another room prior to entering the observed room, the entry behavior for that barrier was considered non-adherent. (7) If a barrier was not worn in the observed room, disposal of that barrier was considered “not applicable.” (8) Since some barrier disposal containers were located outside rooms due to space constraints, disposal of barriers by staff/visitors in these containers was considered adherent if the container was associated with the room. (9) During the study period, institutional policies exempted food-service staff from wearing gowns at all sites and non-staff visitors from gowning and gloving at the children’s hospital; thus, these data were not recorded. (10) In the adult tertiary care hospital, three of six intensive care units (ICUs) practiced a unit policy of universal contact precautions; in those units, all rooms displayed a contact precautions sign and staff/visitors were to practice contact precautions. (11) Due to space constraints in the rehabilitation unit, isolation carts, gloves, and gowns were not required outside isolation rooms; thus, these data were not recorded. Additionally, per unit policy, patients colonized only with methicillin-resistant *Staphylococcus aureus* (MRSA) or vancomycin-resistant enterococci (VRE) were not placed on contact precautions, so data were not recorded unless a contact precautions sign was displayed.

While this study did not quantify the availability of sinks, handwashing supplies, or alcohol-based hand sanitizer, it was noted that sinks and soap were generally available in patient rooms and mounted dispensers of alcohol-based hand sanitizer were universally available in corridors and patient rooms in all units. In addition, some units provided supplementary bottles of alcohol-based hand sanitizer on isolation carts.

Contact Precautions Calculations—The overall burden of contact precautions was measured by calculating patient-days indicated for contact precautions between January-June 2008 from data previously recorded by infection preventionists. Specific reasons for contact precautions during the study period were tabulated using positive culture data from the electronic report. Since some patients had positive cultures for >1 organism, the total patient-days and number of patients indicated for precautions were greater than the number of observations collected per room.

Statistical Analyses—Equipment availability and behavioral adherence was evaluated only for rooms displaying a contact precautions sign. Pearson’s χ^2 test was used to compare contact precautions adherence by hospital, unit type (ICU vs. other), ICU policy (universal contact

precautions vs. not), person observed (patient-care staff vs. other staff and visitors), and, among patient care staff, adherence to one contact precautions behavior by compliance with another behavior (e.g., hand hygiene based upon whether the individual was wearing gloves). Logistic regression was used to examine whether a patient having MRSA, VRE, or *C. difficile* culture was associated with adherence to contact precautions behaviors. Statistical analyses were performed using SPSS Statistics (SPSS, Inc., version 16.0, Chicago, IL).

RESULTS

MDRO Burden

From January-June 2008, 43,624 contact precautions days were indicated at the three study sites, accounting for 23.4% of patient-days (Table 1). The majority (67.2%) of 424 unique patients observed in our study had positive MDRO cultures for one organism; the remaining patients had 2 to 6 species. The highest number of contact days indicated were for VRE (30.6%) and MRSA (22.7%) (Table 2). Of 139 patients with >1 MDRO, 38 were co-colonized with MRSA and VRE, 27 with *K. pneumoniae* and VRE, and 10 to 20 with each of the following: *P. aeruginosa* and VRE, *K. pneumoniae* and MRSA, and *C. difficile* and VRE. Seven patients had *K. pneumoniae*, MRSA, and VRE.

Provision of Supplies—During the 60-day study period, 3,397 room observations were made to determine the availability of signs and equipment. At the time of observation, 2,097 (85.4%) rooms indicated for contact precautions displayed a sign: 85.4% at the community hospital, 75.7% at the children's hospital, and 87.3% at the adult tertiary care hospital (Figure 1). Across the sites, 93.7-96.7% of rooms displaying a contact precautions sign had isolation carts, 49.4-72.1% had all glove sizes, and 91.7-95.2% had gowns.

Contact Precautions Adherence—For rooms with a sign, 1,062 people were observed entering and/or exiting, mostly hospital staff (85.3%). Overall adherence rates were 19.4% for hand hygiene, 67.5% for gloves, and 67.9% for gowns upon room entry and 48.4% for hand hygiene and 63.5% and 77.1% for proper disposal of gloves and gown, respectively, upon room exit (Table 3).

While there was no significant difference between hospitals in adherence to hand hygiene or gloving upon room entry, gowning rates were higher in the adult tertiary care hospital (70.1%) than in the children's (66.7%) or community (51.6%) hospitals ($p=0.011$). No significant differences by hospital were found for exit behaviors.

Adherence rates for all entry and exit behaviors were significantly greater in ICUs than in non-ICUs (all $p<0.05$). However, only gloving upon room entry was significantly better in the ICUs that practiced universal contact precautions than in ICUs that did not (78.1% vs. 65.6%, $p=0.026$).

Patient-care staff had higher adherence rates for all contact precautions behaviors compared with other staff and visitors (all $p<0.05$). Among patient-care staff, performance of any contact precautions behavior was associated with adherence to other behaviors during the observed entry or exit (all $p<0.001$; Table 4). Additionally, while caring for patients with *C. difficile* or VRE was not associated with adherence to contact precautions behaviors, caring for a patient with MRSA was associated with greater hand hygiene and glove disposal adherence upon exit ($p=0.002$ and $p=0.005$, respectively).

Additional Measurements—In the adult tertiary care hospital 530 visitors were observed in patient rooms, but not entering or exiting; 341 (64.3%) were wearing a gown. In the community hospital significantly fewer visitors wore a gown (43.4%, $n=36$; $p<0.001$). Gown-

wearing among visitors was significantly more common in ICUs (96.2%, n=153) than in other types of units (49.3%, n=224; $p<0.001$).

During the study observers recorded 159 instances of environmental contamination, most due to staff/visitor failure to remove gloves worn inside isolation rooms. Other contaminations included visitors entering isolation rooms, interacting with patients, and leaving to retrieve barriers from isolation carts without performing hand hygiene; cleaning staff exiting isolation rooms to retrieve supplies from closets or janitorial carts without removing barriers; and patient-care staff completing tasks outside the room (e.g., using computers, pens, or shared equipment such as glucose readers) without removing gloves worn inside the isolation room.

Equipment-Associated Adherence—The presence of an isolation cart was not associated with adherence to contact precautions, but for rooms where all sizes of gloves were available, adherence to gloving upon entry was higher (72.0% vs. 63.4%; $p=0.032$). Gown availability was not associated with adherence to gowning.

While the evaluations described above only included rooms displaying contact precautions signs, data were also recorded for rooms listed on the electronic report that did not have signs. Gloving and gowning upon entry and proper glove disposal upon exit were significantly more common when signs were present (67.5% vs. 22.7%, 67.9% vs. 2.2%, and 63.5% vs. 23.1%, respectively; all $p<0.005$).

DISCUSSION

Although MDROs have gained recognition as a serious public health threat, institutional adoption of contact precautions and staff awareness of the protocol have not necessarily improved adherence (6,7). A 2008 position paper produced jointly by the Society for Healthcare Epidemiologists of America and HICPAC recommended standardized metrics for monitoring MDRO burden in healthcare facilities, including a daily line listing of patients with MDROs for contact precautions implementation (8). Currently, there are no formal recommendations to evaluate practice or impact of contact precautions, and assessing adherence to contact precautions is subject to the same problems that have been documented for monitoring hand hygiene: prolonged expense of maintaining a surveillance effort, biases like the Hawthorne effect, and practical issues like supply consumption not correlating with practice (9). Despite such pitfalls, direct observation is regarded as the best method for measuring hand hygiene compliance because it provides fundamental information about how practices are performed and who performs them (10).

We measured baseline contact precautions practice rates including initiation of isolation, availability of supplies, and adherence to contact precautions behaviors. Observations were recorded by passive observers to minimize potential Hawthorne effect. The study sample was generalizable, with three types of hospitals, various nursing units, and multiple types of staff/visitors. Previous evaluations of contact precautions were more limited in that they measured only staff adherence, supplies, or ICU settings, or because they were conducted during targeted interventions when multiple factors might have influenced adherence (11-13).

Observed adherence to hand hygiene, 19.4% upon entry and 48.4% upon exit, was not substantially different from other studies (7,13-15). Recently, a deterministic model of MRSA transmission dynamics indicated hand hygiene as the most important action for reducing spread of community strains throughout hospitals, and other studies have shown associations between increased adherence to contact precautions and decreased MDRO rates (15-18). An internal program existed for monitoring hand hygiene at the study sites and had shown improvement in compliance rates over time. We hypothesized that our observations would support a theory

posited in a similarly-designed 1983 study that glove-wearing is perceived as a substitute for hand-sanitizing (19). However, we found that glove-wearing individuals performed hand hygiene more often. Overall, our findings indicate certain individuals (“adherers”) generally comply with the contact precautions protocol and others (“non-adherers”) do not. Similarly, Manian et al. showed that gown use was predictive of glove use among ICU staff during a modified contact precautions period (20). Further, our observation that rates among ICUs did not differ based on practice of universal contact precautions is consistent with this model, since “adherers” are likely perform contact precautions as a set of behaviors regardless of unit policy.

While previous studies reported rates of adherence to barrier precautions upon entry (around 75%), many did not report rates of proper disposal, which infection control guidelines recommend in order to limit potential contamination of surfaces and transmission of MDROs (11,12,20,21). Potential contaminations may contribute to the spread of pathogens known to survive on fomites, such as *Acinetobacter* species (22,23). VRE, MRSA, *P. aeruginosa*, and *A. baumannii* have been obtained from gloves and gowns of healthcare workers after contact with colonized/infected patients, and Smith et al. recently reported culture of drug-resistant *A. baumannii* from workers’ hands following glove removal (24,25). We observed that hand hygiene and gowning adherence rates were higher upon exit than upon entry. However, appropriate disposal of gloves upon exit was lower than rates of gloving upon entry, especially for non-ICUs, visitors, and non patient-care staff. Continuing to wear gloves used in contact precautions rooms was the most frequently observed cause of environmental contamination; this was especially common among non patient-care staff, which might indicate fundamental misunderstandings about pathogen containment among these employees.

As in other hospitals, contact precautions in this patient population were mainly due to VRE, MRSA, *C. difficile*, and gram-negative MDROs. Greater adherence by patient-care staff (vs. other staff) might relate to awareness of the infecting MDRO. We tested the hypothesis that staff recognition of high-profile MDROs (MRSA, VRE, or *C. difficile*) predicts better adherence and found MRSA-patient-positivity was predictive of some exit behaviors.

Limitations

Observations were collected over a three-month period, so changes in practice over time would not have been captured and the MDRO burden could have been influenced by seasonality. Additionally, observers oversampled daytime and weekday shifts and generated the electronic report once per day, so real-time negative cultures or clinical decisions to remove patients from isolation were not reflected. Chart reviews were not performed to capture the reasons for missing signs.

The measurement for gloves did not capture the availability of gloves inside the room or how many sizes (<3) were available. Finally, observations of patient rooms and staff/visitor behavior were not independent, as patients on contact precautions >1 day may have been observed >1 day, and staff/visitors may have been observed entering/exiting isolation rooms multiple times.

Conclusions and Recommendations

Contact precautions are a critical measure for preventing the spread of MDROs, but implementation is a challenge at many institutions. It is clear that positive MDRO results alone are not sufficient to determine whether contact precautions are initiated, since nearly 15% of patients indicated were without a contact precautions sign at the time of our observation. Measures to ensure timely initiation of isolation and adequate availability of contact precautions supplies are likely to promote adherent practices. Clarifying precisely when and how patients with MDRO cultures are placed on contact precautions and adding interactive

electronic databases for infection preventionists, along with multiple routes for electronic dissemination of contact precautions requirements, may help achieve better initiation of isolation. Immediate display of a contact precautions sign, during initiation of isolation, may be a crucial factor for improving behavioral adherence rates. Finally, education targeted to “non-adherers,” cleaning and food-service staff, and visitors may help correct non-adherent practices.

Regular monitoring of contact precautions is important to ascertain whether the guidelines are being followed and have any impact. A component of such a monitoring process should be feedback to unit leaders and recommendations for unit-level changes. As in our study, data from monitoring processes can be used by hospital infection prevention and control programs to (1) standardize and augment policies across the institution, (2) improve existing methods to educate staff about contact precautions and increase behavioral adherence, and (3) revise the design of planned interventions to allow clinicians to track the requirements for isolation initiation/discontinuation for patients colonized/infected with MDROs.

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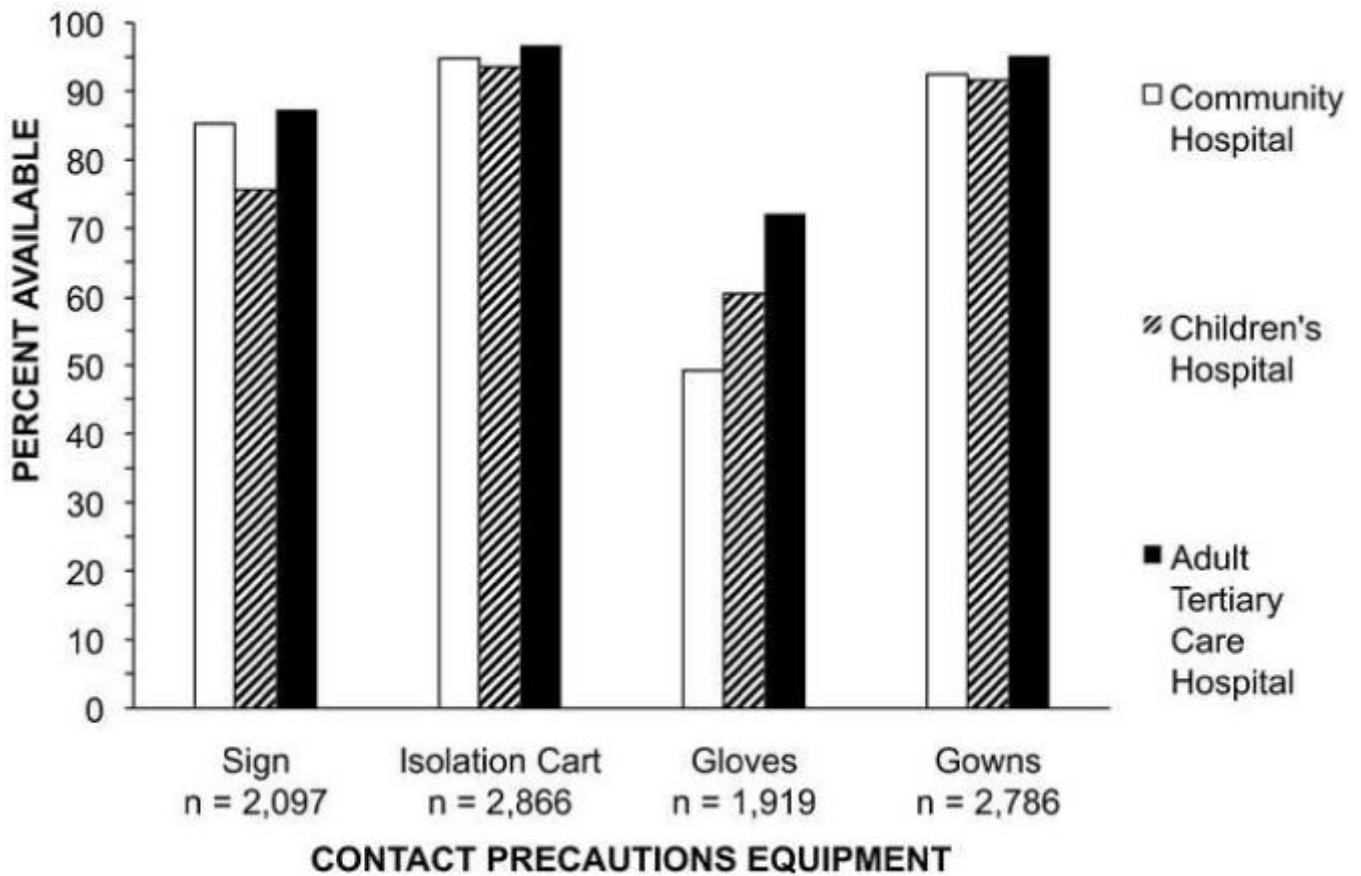


Figure 1. Availability of Contact Precautions Equipment by Hospital Site. Rates are reported as percent available for contact precautions sign, isolation cart, gloves (all sizes: small, medium, and large), and gowns. n = no. observations of available equipment for all three sites. NOTE: n = no. observations of available equipment for all three sites.

Table 1

Sites and Collected Observations

HOSPITAL TYPE	SITE CHARACTERISTICS				DISTRIBUTION OF OBSERVATIONS				
	Certified Beds	Hospital Patient-Days ^a	Contact Precautions Patient-Days ^a	Patient Rooms	% (no.) Within ICUs	Staff Adherence to Contact Precautions	Visitor Adherence to Contact Precautions	Mean Patient Rooms per Day	
Community	221	33,139	6,361	409	9.8 (40)	82	17	20.5	
Children's	283	46,697	5,762	549	36.6 (201)	134	19	27.5	
Adult Tertiary Care	692	106,476	31,501	2,439 ^b	27.3 (667) ^b	690 ^b	120 ^b	122.0 ^b	
Total	1,196	186,312	43,624	3,397 ^b	26.7 (908) ^b	906 ^b	156 ^b		

^aPatient-days were estimated over six months: January-June 2008.^bObservations include patient rooms in ICUs practicing universal contact precautions.

Table 2

Reason for Contact Precautions

CULTURE TYPE	DAYS ^a % (no.)	PATIENTS ^a % (no.)
Vancomycin-resistant enterococci (VRE)	30.6 (1,152)	28.4 (181)
Methicillin-resistant <i>Staphylococcus aureus</i> (MRSA)	22.7 (856)	25.7 (164)
<i>Klebsiella pneumoniae</i>	10.3 (388)	8.3 (53)
<i>Clostridium difficile</i>	9.8 (369)	10.0 (64)
Other gram-negatives	8.3 (313)	5.2 (33)
<i>Pseudomonas aeruginosa</i>	6.5 (247)	5.9 (38)
<i>Escherichia coli</i>	5.2 (195)	5.6 (36)
<i>Acinetobacter baumannii</i>	3.5 (132)	2.7 (17)
Screening ^b	2.8 (105)	7.7 (49)
Other ^c	0.3 (12)	0.5 (3)
Total	100 (3,769)	100 (638)

^aData for days represent more than the unique patient-days observed because some patients had cultures for >1 organism. For this reason, data for patients also represent more than the unique patients observed.

^bScreening cultures were for MRSA, VRE, or extended spectrum beta-lactamase (ESBL)-producing gram-negatives for patients who also had a positive culture.

^cIncludes respiratory syncytial virus (RSV) and rotavirus.

Table 3
Adherence to Contact Precautions Protocol by Type of Hospital, Unit, and Person Observed

	OVERALL	TYPE OF HOSPITAL				TYPE OF UNIT			TYPE OF PERSON			
		Community	Children's	Adult Tertiary Care	P	ICU	Non-ICU	P	Patient-Care Staff	Other Staff	Visitors	P
Room Entry:												
Hand Hygiene	19.4	16.0	25.0	18.9	0.405	23.2	16.0	0.034	22.4	10.5	10.8	0.011
n = 547	(106)	(8)	(17)	(81)		(60)	(46)		(91)	(6)	(9)	
Gloves	67.5	58.2	66.7	68.8	0.213	72.8	62.8	0.006	71.6	61.2	46.9	<0.001
n = 662	(447)	(39)	(50)	(358)		(228)	(219)		(368)	(41)	(38)	
Gown	67.9	51.6	66.7	70.1	0.011	82.6	54.1	<0.001	71.0	42.9	63.0	<0.001
n = 657	(446)	(33)	(50)	(363)		(262)	(184)		(374)	(21)	(51)	
Room Exit:												
Hand Hygiene	48.4	39.6	50.0	49.2	0.402	55.9	42.1	0.001	59.0	25.4	9.7	<0.001
n = 558	(270)	(21)	(42)	(207)		(142)	(128)		(245)	(18)	(7)	
Gloves	63.5	50.0	62.5	65.1	0.261	70.5	56.7	0.007	72.5	27.4	52.4	<0.001
n = 356	(226)	(15)	(30)	(181)		(124)	(102)		(198)	(17)	(11)	
Gown	77.1	57.9	83.8	77.6	0.085	84.4	67.6	<0.001	83.9	40.7	57.9	<0.001
n = 319	(246)	(11)	(31)	(204)		(152)	(94)		(213)	(11)	(22)	

NOTE: n = no. observations per contact precautions behavior. Data are % (no.) adherence to contact precautions. Comparison of the difference in adherence to contact precautions behaviors by type of hospital, unit, or person was performed using Pearson's χ^2 analysis.

Table 4
Patient-Care Staff Compliance and Adherence to Other Contact Precautions Behaviors

	HAND HYGIENE COMPLIANCE					GLOVE COMPLIANCE					GOWN COMPLIANCE				
	n	Overall	Yes	No	P	n	Overall	Yes	No	P	n	Overall	Yes	No	P
Room Entry:															
Hand Hygiene	--	--	--	--	--	402	22.1 (89)	29.8 (79)	7.3 (10)	<0.001	405	22.5 (91)	31.1 (83)	5.8 (8)	<0.001
Gloves	402	65.9 (265)	88.8 (79)	59.6 (186)	<0.001	--	--	--	--	--	512	71.9 (368)	90.3 (327)	27.3 (41)	<0.001
Gown	405	65.9 (267)	91.2 (83)	58.6 (184)	<0.001	512	70.7 (362)	88.9 (327)	24.3 (35)	<0.001	--	--	--	--	--
Room Exit:															
Hand Hygiene	--	--	--	--	--	345	56.5 (195)	79.0 (143)	31.7 (52)	<0.001	365	56.4 (206)	76.8 (152)	32.3 (54)	<0.001
Gloves	345	52.5 (181)	73.3 (143)	25.3 (38)	<0.001	--	--	--	--	--	357	54.3 (194)	87.3 (165)	17.3 (29)	<0.001
Gown	365	54.2 (198)	73.8 (152)	28.9 (46)	<0.001	357	52.9 (189)	85.1 (165)	14.7 (24)	<0.001	--	--	--	--	--

NOTE: n = no. observations per contact precautions behavior. Data are % (no.) adherence to contact precaution behaviors in the first column. For gloves and gown exit behaviors, failure to comply (Compliance = No) was either failure to wear or failure to dispose of the barrier properly. Comparison of adherence to one behavior by compliance to another behavior during the observed entry/exit was performed using Pearson's χ^2 analysis.