

Healthcare Professionals' Adherence to Contact Precautions at a Maternal and Child Teaching Hospital

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Abstract

Background: Healthcare-associated infections affect hundreds of millions of patients worldwide. Children have greater susceptibility to healthcare-associated infections due to the immaturity of their immune system. Contact precautions aim to promote safety, protection and prevention of contamination. Thus, the objective of this study was to verify adherence to contact precaution measures, as well as compliance to the use of personal protective equipment.

Methods: This cross-sectional observational study was carried out from July to October 2019 using a checklist to evaluate health professionals' adherence to hand hygiene procedures and the use of gloves and surgical gowns when assisting children on contact precautions. **Results:** A total of 941 observations were carried out in a total of 300.532 hours. Hand hygiene was performed before and after contact with the patient in 58.84% and 75.09% of the cases, respectively and a surgical gown was used in 86.40% of the cases. The use of gloves was the variable most adhered to by professionals (87.57%). Intensive care unit professionals were the care workers who most complied with the regulation regarding hand hygiene after contact with the patient ($p = 0.009$) and the use of the surgical gown ($p < 0.001$). The correct hand hygiene technique was the recommendation with least adherence. Non-compliance to the hand hygiene technique was statistically significant among intensive care unit professionals ($p = 0.002$). **Conclusions:** Adherence to hand hygiene before contact with the patient and compliance with the hand hygiene technique were neglected by most professionals. However, there was good adherence to the use of surgical gloves and gowns, as well as high compliance to the techniques of removing these items.

Keywords

Hospital Infection, Universal Precautions, Patient Safety, Pediatric Nursing, Isolation of Patients, Microbial Drug Resistance

1. Introduction

Healthcare-associated Infections (HAIs) are understood to be any infection acquired during the care process after the patient's admission to the hospital environment; they may manifest during hospitalization or after discharge [1].

Children have greater susceptibility to HAI due to the immaturity of their immune system. In addition, situations of prematurity and low birth weight require invasive procedures thereby increasing risk [2]. HAIs reflect in increased complications and complexity of treatment since they increase morbidity, mortality, and child and family suffering, as well as length of hospitalization and treatment cost [3].

As a means of preventing the transmission of multidrug-resistant microorganisms in the hospital environment, professionals use personal protective equipment (PPE) and techniques called contact precautions during the care of these patients [4].

Contact precautions are indicated in cases of excessive wound drainage, fecal incontinence and the presence of other body fluids that are potential environment contaminators from patients infected or contaminated with multidrug-resistant microorganisms, as well as in cases of increased contamination risk. These clinical conditions carry a sufficiently high risk to call for the practical application of isolation precautions, empirical contact precautions, while waiting for a clear diagnosis. This occurs when a patient is admitted to a tertiary facility after referral from another health service because of the possibility of colonization by a multi-resistant microorganism. In these empirical cases, the same contact precaution measures used in patients infected or colonized with multidrug-resistant bacteria are adopted. The use of an isolation room is recommended with the door always being kept closed. However, if it is impossible to keep the door shut, it is important to keep the patient at least six feet away from other patients [4].

Contact precautions, as recommended in the Guidelines for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings and defined in the Regulatory Standard No. 6 approved in 1978, are one of several regulations of the Consolidation of Brazilian Labor Laws, which includes hand hygiene, and the use of gloves and surgical gowns as PPE. The objective is to promote safety, protection, and prevention of contamination among professionals and patients [5]. Above all, PPEs are indispensable for the entire team that care for patients with HAIs. When healthcare professionals do not follow the recommended protective measures while treating patients on contact precautions, they increase the risk of cross-contamination [6]. As multidrug-resistant microorganisms are the most common cause for the increase in HAIs, it is ne-

cessary to adopt strict contact precaution measures [7].

The incidence of multi-resistant bacteria in recent decades has increased, thereby further complicating the treatment of some HAIs. In addition, there is a consensus that bacterial resistance is an important factor in increasing mortality rates of critically ill patients [8]. In view of these mortality rates, the compliancy of all health professionals to the contact precaution guidelines has become essential when caring for patients with resistant microorganisms. In doing so, they will help to avoid the spread of multi-resistant bacteria in the hospital environment and to reduce occupational risk [9]. The most common multidrug-resistant bacteria responsible for hospital infections are *Staphylococcus aureus*, *Enterobacteria*, the CESP group of bacteria (*Citrobacter* spp., *Enterobacter* spp., *Serratia* spp. and *Providencia* spp.), *Enterococcus*, *Klebsiella pneumoniae*, and *Acinetobacter* sp. [10].

As cross-contamination of organisms occurs due to contaminated hands that promote the transfer of microorganisms from one surface to another, it is worth noting that around 30% of hospital infections can be prevented by hand hygiene with water and soap, 70% alcohol (gel) or by degerming solution [11].

However, clinical audits are still needed to evaluate whether health professionals are following the contact precaution guidelines [12]. These measures support staff training and development since the use of PPEs is still a challenge due to lack of training, long working hours and inadequate concern among the professionals themselves [13].

Given these considerations, this study aims to verify both adherence to contact precautions including compliance of the correct techniques of PPE removal in a teaching hospital specialized in children's and women's health.

2. Method

The methodology used was a cross-sectional observational study with a descriptive design and a quantitative analytical approach with correlation between variables. The research setting is a 201-bed teaching hospital in southeastern Brazil, which is specialized in children's and women's health.

Of these hospital beds, 49 are designated for gynecology and obstetrics and 152 beds are assigned to pediatrics. Of the pediatric beds, 55 are on children's wards and 97 are in intensive care units (ICUs). Of the ICU beds, 39 are designated for general pediatrics, 23 for pediatric cardiology, 16 for neonatology, and 19 for neonatal intermediate care. The service is intended for users of the public healthcare system, various health insurance companies and healthcare providers. It is important to highlight that 16 patients on average are hospitalized per month on contact precautions.

Every day from July 1st to October 31st 2019, the Hospital Infection Control Commission (HICC) provided the locations of patients on contact precautions aged between 0 and 12 years old. These included children infected or contaminated by carbapenems-resistant *Pseudomonas* spp. and *Acinetobacter* spp., vancomycin-resistant *Enterococcus* spp., carbapenemase-producing or carbapenem-

resistant gram-negative bacteria, microorganisms resistant to all classes of antimicrobials and other bacteria with a multidrug-resistant profile as defined by the HICC, such as multidrug-resistant *Staphylococcus sp.*

All professionals who treated patients on contact precautions during the period of the observations were included as the study population. The information related to the adherence of health professionals to contact precaution guidelines was collected through observations in the three work shifts (morning, afternoon, and night), both on the wards and in ICUs.

A practical tool adapted from the Manual for Reasoned Observers: “The World Health Organization Multimodal Hand Hygiene Improvement Strategy” was used for the observations. The manual was translated by Sátia Marine [Brasília: Pan American Health Organization; Brazilian Health Surveillance Agency (ANVISA)]. The instrument is composed of identification data such as city, institution, and name of the observer, date, and duration of the session, working shift, hospital unit (ward or ICU) and professional category [14]. The following variables were observed: hand hygiene before and after patient care, use of gloves and of surgical gown. Compliance was also assessed on the correct hand washing techniques, PPE, and removal of gloves and surgical gown. If any of the variables were not marked in the instrument, they were excluded at the end of the analysis.

Prior to observations, a 40-minute on-the-job training session was provided by the HICC nurse to seven third-year nursing students of the São José do Rio Preto Medical School (FAMERP) undergraduate nursing course, who participated in data collection with a checklist being presented during training. A pilot test was carried out for a month before the start of data collection so that the results could be compared with those of the instructor and any doubts could be discussed. The instructor and observers communicated during the entire data collection process. The observers were instructed to start a stopwatch when the healthcare professional started hand hygiene before beginning patient care and stop it at the end of hand hygiene after contact with the patient. If the professional did not perform hand hygiene before contacting the patient, the stopwatch was started when care began and stopped only after removing the PPE. It is believed that the use of a stopwatch is relevant in checking the duration of the observation of professionals.

Compliance with the technique of using a surgical gown was considered when it was removed inside out after removing the gloves without contact with the external region of the gown. The correct technique for using gloves was observed when they were removed before the surgical gown, first removing one of the gloves by turning it inside out and then the second glove covering the first, without any contact of the hands on the external surfaces of the gloves. The hand hygiene technique, both with soap and water and with alcohol solution, was considered compliant when performed following the five steps established by the health institution of the study. These are: 1) apply the product to the hands and rub them; 2) rub the palm of the right hand against the back of the left hand and

vice versa; 3) rub the spaces between the fingers; 4) rub the thumbs; 5) rub the fingers and nails of one hand against the palm of the opposite hand and rinse the soap with water. Hand hygiene was considered adequate when performed both before having contact with the patient and immediately after providing care.

Information, such as registration, culture and antibiogram tests related to each patient observed were retrieved from the electronic medical records. Data were recorded on a form specifically designed by the author. Variables recorded included identification data (service code and medical records of each patient), hospitalization unit, bed number, name, gender, age, and city of origin. The reason for hospitalization was also identified in the patient's medical record as was the length of hospitalization. The medical specialty that attended the patient, the International Classification of Diseases (ICD) 10 and results of exams (clinical specimens and antibiogram) were also recorded.

This project was approved by the Ethics Committee of the Medicine School in São José do Rio Preto (approval number 3.277.936).

Statistical Methods

Descriptive and inferential statistics were used to analyze data. Data were tabulated in Excel and are expressed in absolute and relative numbers. Regarding inferential statistics, the analysis of independence and prediction of the variables used the Mann-Whitney U test. Analyses used the SPSS software version 23 in the Microsoft Excel program version 2016.

3. Results

A total of 941 observations were made over 300.53 hours. The average time of observation was 19.16 minutes (SD \pm 14.8), ranging from five minutes to 3 hours distributed across shifts: morning (29.88%), afternoon (38.50%) and night (31.62%) (**Table 1**). It is noteworthy that 147 (15.62%) observations were made on wards and 794 (84.38%) in the ICU.

Registered nurses were the healthcare professionals most observed in 8730.05 minutes (48.41%) of observations recorded. Subsequently, in decreasing order of observation, were licensed practical nurses and nursing assistants (4469.05 minutes; 24.78%), physical therapists (3228.13 minutes; 17.90%), physicians (1499.72 minutes; 8.32%), speech therapists (44 minutes; 0.24%), biomedical professionals (31 minutes; 0.17%) and radiologists (30 minutes; 0.17%).

Table 1. Distribution of the time spent on observations by shift. São José do Rio Preto, 2023.

Shift	Hours	%
Morning	89.79	29.88
Evening	115.71	38.50
Night	95.03	31.62
Total	300.53	100.00

The observations involved 78 children on contact precautions. Of these, 37 (47.44%) were female and 41 (52.56%) were male. The mean age was 26.6 ± 42.38 months ranging from one to 156 months. Regarding hospitalization units, 57 (73.08%) children were in the ICU and 21 (26.92%) were on wards. As for contact precautions, 29 (37.18%) were empirical, while 49 (62.82%) children had already been identified as being infected by multi-resistant microorganisms, 12 (15.38%) of the children died.

In respect to biological samples, 82 multidrug-resistant microorganisms were isolated in 71 biological cultures. Of these, 18 (25.35%) were found in urinary antibody-coated bacteria tests, 14 (19.72%) in blood cultures, 14 (19.72%) in surveillance cultures for *Klebsiella pneumoniae carbapenemase* (KPC) on swabs; 12 (16.9%) in tracheal aspirates; 12 (16.9%) in cultures for bacteria, and one (1.41%) in stool tests. Among these pathogens, *Staphylococcus epidermidis* was the most common accounting for 14.29% (n = 12), all cases of which were isolated in ICU patients. Multi-resistant bacteria were distributed as follows: 67 (82.14%) of the bacteria were found in the ICU and 15 (17.86%) on hospital wards (Table 2).

Table 2. Distribution of pathogens in patients in contact precaution according to the patient's place of admission. São José do Rio Preto. 2023.

Microorganism	UI - n%	UTI - n%
<i>Staphylococcus epidermidis</i>	0 (0)	12 (100.0)
<i>Escherichia coli</i>	3 (30.00)	7 (70.00)
<i>Staphylococcus aureus</i>	2 (22.20)	7 (77.78)
<i>Pseudomonas aeruginosa</i>	2 (25.00)	6 (75.00)
<i>Klebsiella pneumoniae</i>	3 (37.50)	5 (62.50)
<i>Enterobacter cloacae</i>	1 (20.00)	4 (80.00)
<i>Enterococcus faecalis</i>	1 (20.00)	4 (80.00)
<i>Staphylococcus haemolyticus</i>	0 (0.00)	4 (100.00)
<i>Staphylococcus hominis</i>	0 (0.00)	4 (100.00)
<i>Proteus mirabilis</i>	0 (0.00)	3 (100.00)
<i>Candida tropicalis</i>	0 (0.00)	2 (100.00)
<i>Acinetobacter baumannii</i>	0 (0.00)	2 (100.00)
<i>Moraxella catarrhalis</i>	0 (0.00)	2 (100.00)
<i>Candida albicans</i>	1 (50.00)	1 (50.00)
<i>Serratia marcescens</i>	1 (50.00)	1 (50.00)
<i>Neisseria elongata</i>	0 (0.00)	1 (100.00)
Outros**	1 (33.33)	2 (66.67)

Analyzing the profile of bacterial resistance against antimicrobials, 173 profiles were identified. The β -lactam class (Amoxicillin/Ampicillin/Oxacillin/Amoxicillin-clavulanate) was the most common in relation to resistance ($n = 39$; 22.54%), followed by carbapenems (Imipenem/Meropenem/Ertapenem— $n = 21$; 12.14%), aminoglycosides (Amikacin/Gentamicin), and quinolones (Ciprofloxacin/Levofloxacin— $n = 20$; 11.56%). Third generation cephalosporins (Ceftriaxone/Ceftazidime— $n = 19$; 10.98%), and macrolides (Azithromycin— $n = 12$; 6.94%) were also identified, as were the fourth-generation cephalosporin (Cefepime) and sulfonamides (Sulfamethoxazole) ($n = 11$; 6.36%) and lincosamides (Clindamycin— $n = 10$; 5.78%), β -lactamase inhibitors (Piperacillin— $n = 7$; 4.05%), nitrofurans (Nitrofurantoin— $n = 1$; 0.58%), and Rifampicin ($n = 2$; 1.16%).

Regarding the variables of contact precautions, there was greater adherence to hand hygiene before contact with the patient ($n = 163$; 58.84%), hand hygiene after contact with the patient ($n = 208$; 75.09%), use of the surgical gown ($n = 244$; 88.09%) and the use of gloves ($n = 245$; 88.45%) in the morning shift.

As for the compliance to the execution of the techniques according to the work shift, the night-shift professionals performed hand hygiene the best ($n = 71$; 23.99%). The morning shift presented the best compliance to safe surgical gown removal ($n = 209$; 75.45%), while the best compliance to the glove removal technique was observed in the afternoon ($n = 313$; 85.05%). Overall, it was also observed that hand hygiene was performed correctly by 218 (23.17%) professionals, removal of the surgical gown by 656 (69.71%), and removal of gloves by 799 (84.59%) (**Table 3**).

Regarding the contact precaution variables, hand hygiene was performed more frequently after contact with the patient ($n = 696$; 73.96%) than before contact ($n = 490$; 52.07%). This fact was also observed when personnel categories were analyzed separately, except for radiology, in which it was observed to be performed only once (33.33%), that is, after contact with the patient. Greater compliance was observed on the part of professionals regarding the use of gloves and surgical gowns in 824 (87.57%) and 813 (86.40%) cases. Analyzing these variables by categories, this fact was identified with the use of gloves, ranging from 82.55% to 100%, while the use of the surgical gown ranged from 80.43% to 100% (**Table 4**).

In the overall analysis of the technical compliance of hand hygiene, it was observed that 558 (59.30%) employees performed it incorrectly. This was not true when analyzing conformity to the surgical gown removal technique because most of the 656 professionals (69.70%) performed it correctly, as well as the technique for removing gloves 799 (84.91%) (**Table 4**).

Among the professional categories physical therapy was the one with a best conformity to all the recommendations for contact precautions. There were no statistically significant differences between the variables observed and the different professional categories with p -values ranging from 0.058 to 0.723 (**Table 4**).

Table 3. Distribution of the adherence of health professionals to the contact precaution variables according to the work shift. São José do Rio Preto, 2023.

<i>Variables</i>	<i>Morning</i>		<i>Afternoon</i>		<i>Night</i>		<i>TOTAL</i>		<i>Value</i>
	<i>N</i>	<i>%</i>	<i>N</i>	<i>%</i>	<i>N</i>	<i>%</i>	<i>N</i>	<i>%</i>	<i>p</i>
HH Before	277	100.00	368	100.00	296	100.00	941	100.00	
<i>No</i>	114	41.16	177	48.10	156	52.70	447	47.50	0.006
<i>Yes</i>	163	58.84	191	51.90	140	47.30	494	52.50	
HH After									
<i>No</i>	69	24.91	94	25.54	82	27.70	245	26.04	0.449
<i>Yes</i>	208	75.09	274	74.46	214	72.30	696	73.96	
Correct HH technique									
<i>No</i>	172	62.09	217	58.97	169	57.09	558	59.30	0.235
<i>Yes</i>	59	21.30	88	23.91	71	23.99	218	23.17	
<i>nd</i>	46	16.61	63	17.12	56	18.92	165	17.53	
Surgical gown									
<i>No</i>	33	11.91	49	13.32	46	15.54	128	13.60	0.209
<i>Yes</i>	244	88.09	319	86.68	250	84.46	813	86.40	
Correct surgical gown technique									
<i>No</i>	35	12.64	67	18.21	55	18.58	157	16.68	0.704
<i>Yes</i>	209	75.45	252	68.48	195	65.88	656	69.71	
<i>nd</i>	33	11.91	49	13.32	46	15.54	128	13.60	
Gloves									
<i>No</i>	32	11.55	44	11.96	41	13.85	117	12.43	0.410
<i>Yes</i>	245	88.45	324	88.04	255	86.15	824	87.57	
Correct gloves technique									
<i>No</i>	9	3.25	11	2.99	8	2.70	28	2.98	0.314
<i>Yes</i>	236	85.20	313	85.05	247	83.45	796	84.59	
<i>nd</i>	32	11.55	44	11.96	41	13.85	117	12.43	

HH: Hand Hygiene.

Analyzing the contact precaution variables according to the hospital unit, similar percentages were found for hand hygiene before contact with the patient with wards accounting for 76 (51.70%) and ICUs accounting for 418 (52.54%). A higher frequency of compliance to hand hygiene after contact was identified in ICUs ($n = 600$; 75.57%; $p = 0.009$). However, when the compliance of this technique was verified, there was statistical significance ($p = 0.002$) in relation to non-compliance for the ICU. As for the use of the surgical gown, there was greater compliance in the ICU ($p = 0.000$), as well as greater compliance regarding its removal technique ($p = 0.014$), but this was not evidenced in relation to the gloves, which was similar for all variables (Table 5).

Table 4. Distribution of adherence to the precaution variables by professional category. São José do Rio Preto, 2023.

Variables	Nurses		Nursing assistants		Physicians		Doctor		Speech Therapists		Biomedical professionals		Radiologists		TOTAL	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
No	201	45.79	133	56.60	59	36.20	53	54.64	2	100.00	2	100.00	1	33.33	451	47.93
Yes	238	54.21	102	43.40	104	63.80	44	45.36	0	0.00	0	0.00	2	66.67	490	52.07
TOTAL	439	100.00	235	100.00	163	100.00	97	100.00	2	100.00	2	100.00	3	100.00	941	100.00
HH After (p = 0.156)	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
No	128	29.16	79	33.62	79	5.52	26	26.80	0	0.00	1	50.00	2	66.67	245	26.04
Yes	311	70.84	156	66.38	154	94.48	71	73.20	2	100.00	1	50.00	1	33.33	696	73.96
nd	439	100.00	235	100.00	163	100.00	97	100.00	2	100.00	2	100.00	3	100.00	941	100.00
Correct HH technique (p = 0.723)	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
No	247	56.26	138	58.72	107	65.64	63	64.95	1	50.00	1	50.00	1	33.33	558	59.30
Yes	111	25.28	40	17.02	49	30.06	14	14.43	1	50.00	1	50.00	2	66.67	218	23.17
nd	81	18.45	57	24.26	7	4.29	20	20.62	0	0.00	0	0.00	0	0.00	165	17.53
TOTAL	439	100.00	235	100.00	163	100.00	97	100.00	2	100.00	2	100.00	3	100.00	941	100.00
Surgical gown (p = 0.504)	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
No	57	12.98	46	19.57	8	4.91	17	17.53	0	0.00	0	0.00	0	0.00	128	13.60
Yes	382	87.02	189	80.43	155	95.09	80	82.47	2	100.00	2	100.00	3	100.00	813	86.40
TOTAL	439	100.00	235	100.00	163	100.00	97	100.00	2	100.00	2	100.00	3	100.00	941	100.00
Correct surgical gown technique (p = 0.058)	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
No	82	18.91	32	13.62	25	15.34	16	16.49	0	0.00	0	0.00	2	66.67	157	16.68
Yes	300	68.34	157	66.81	130	79.75	64	65.98	2	100.00	2	100.00	1	33.33	656	69.7
nd	57	12.98	46	19.57	8	4.91	17	17.53	0	0.00	0	0.00	0	0.00	128	13.60
TOTAL	439	100.00	235	100.00	163	100.00	97	100.00	2	100.00	2	100.00	3	100.00	941	100.00
Gloves (p = 0.491)	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
No	60	13.67	41	17.45	6	3.68	10	10.31	0	0.00	0	0.00	0	0.00	117	12.43
Yes	379	86.33	194	82.55	157	96.32	87	89.69	2	100.00	2	100.00	3	100.00	824	87.57
TOTAL	439	100.00	235	100.00	163	100.00	97	100.00	2	100.00	2	100.00	3	100.00	941	100.00
Correct gloves technique (p = 0.675)	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
No	14	3.19	7	2.98	3	1.84	1	1.03	0	0.00	0	0.00	0	0.00	25	2.66
Yes	365	83.14	187	79.57	154	94.48	86	88.66	2	100.00	2	100.00	3	100.00	799	84.91
nd	60	13.67	41	17.45	6	3.68	10	10.31	0	0.00	0	0.00	0	0.00	117	12.43
TOTAL	439	100.00	235	100.00	163	100.00	97	100.00	2	100.00	2	100.00	3	100.00	941	100.00

nd: Not done; HH: Hand Hygiene.

Table 5. Distribution of adherence to the contact precaution variables according to observation site. São José do Rio Preto, 2023.

<i>Variables</i>	<i>HU</i>		<i>ICU</i>		<i>TOTAL</i>		<i>Value p</i>
	<i>N</i>	<i>%</i>	<i>N</i>	<i>%</i>	<i>N</i>	<i>%</i>	
HH Before	147	100.00	794	100.00	941	100.00	
<i>No</i>	71	48.30	376	47.36	447	47.50	0.833
<i>Yes</i>	76	51.70	418	52.64	494	52.50	
HH After							
<i>No</i>	51	34.69	194	24.43	245	26.04	0.009
<i>Yes</i>	96	65.31	600	75.57	696	73.96	
HH Correct technique							
<i>No</i>	72	48.98	486	61.21	558	59.30	0.002
<i>Yes</i>	37	25.17	181	22.80	218	23.17	
<i>nd</i>	38	25.85	127	15.99	165	17.53	
Surgical gown							
<i>No</i>	34	23.13	94	11.84	128	13.60	0.000
<i>Yes</i>	113	76.87	700	88.16	813	86.40	
Correct surgical gown technique							
<i>No</i>	22	14.97	136	17.13	158	16.79	0.014
<i>Yes</i>	93	63.27	565	71.16	658	69.93	
<i>nd</i>	32	21.77	93	11.71	125	13.28	
Gloves							
<i>No</i>	23	15.65	94	11.84	117	12.43	0.199
<i>Yes</i>	124	84.35	700	88.16	824	87.57	
Correct gloves technique							
<i>No</i>	4	2.72	24	3.02	28	2.98	0.272
<i>Yes</i>	121	82.31	678	85.39	799	84.91	
<i>nd</i>	22	14.97	92	11.59	114	12.11	

nd: Not done; HH: Hand Hygiene.

4. Discussion

From the results of this research, there was a predominance of male patients - 52.56%. This prevalence was also found in studies conducted in hospitals in Minas Gerais State and Rio Grande do Sul State, which reported prevalences of 57.6% and 57.2% of male patients, respectively [15] [16]. However, although other authors reported similar findings, no statistical significance was identified.

Care was observed of 78 individuals on contact precautions; in 62.82% of cases, the microorganism had already been identified in culture examinations. The most prevalent microorganism, found only in patients in the ICU, was *Staphy-*

Staphylococcus epidermidis. This bacterium is not classified as potentially pathogenic; it is present in the skin and mucous membranes in most humans [17]. However, it should be remembered that *Staphylococcus epidermidis* can be pathogenic in immunosuppressed patients and after invasive procedures such as the introduction of central venous catheters [18].

In the present study, antimicrobial resistance was found much more frequently in relation to β -lactam antibiotics. A study conducted at the Júlio Müller University Hospital of the Federal University of Mato Grosso (UFMT) found that, in pediatrics, the coagulase-negative *Staphylococcus* group, in which *Staphylococcus epidermidis* is included, was the most widely found. In addition, the greatest resistance of coagulase-negative *Staphylococci* against antibiotics was in respect to Oxacillin (60%), found even in the neonatal ICU (87.5%) [19].

Professionals who care for patients are the main means of microorganism transmission, especially when they do not adhere to the necessary precautions to avoid infections. A high rate of HAI may indicate that professionals do not adhere to fundamental precautions. When measuring this indicator, in addition to monitoring it, it is also necessary to evaluate the structure and processes involved. Therefore, it is necessary to carry out audits, especially in teaching hospitals; the location of initial and continuing training of students, resident physicians, and health professionals [20] [21].

Regarding the contact precaution variables per work shift, it was found that the night shift showed less compliance to hand hygiene before contact with the patient (47.30%). A study carried out in an emergency care unit of a large university hospital in Belo Horizonte, Minas Gerais State, showed greater adherence to hand hygiene by professionals on the night shift [22]. Studies indicate that night workers, due to the reversal of the sleep-wake cycle, when working at a time when their physiological levels of vigilance and efficiency are low; complain of headache, fatigue, and sleepiness, which can compromise the quality of care [23] [24].

As for the professionals' compliance to the contact precaution variables, it was observed that although hand hygiene is a simple and well-known measure, it was the technique with the least compliance among professionals, especially during the moment that precedes contact with the patient (52.07%). It was also the one with the lowest compliance (59.30%). According to the World Health Organization, to be considered effective hand rub with an alcoholic preparation must comprise five steps and last from 20 to 30 seconds, and these steps are those recommended by the institution of this study [25]. According to Regulatory Standard 32, which establishes the individual protection measures for health service workers, the use of gloves does not replace the hand hygiene process, which should occur at least before and after their use [26].

The findings of this study are of great concern especially when it comes to preventive measures and patient safety. Although no statistical significance was found between the professional categories ($p = 0.156$), the results are disturbing, particularly regarding the nursing team, considering their qualification, their

proximity to care, and the time spent with the client. It is important to highlight that the use of PPE is a contact barrier against contamination. Therefore, it helps to protect the employee as well as the patients who are being treated [27] [28].

An observational multicenter study conducted in 11 hospitals in the United States of America, similar to this, indicated hand hygiene before contact with the patient was the least met contact precaution variable (37.2%) [29]. Similarly, another observational study carried out in an ICU of a University Hospital in southern Brazil also identified hand hygiene before contact as the least complied with item (35.8%) [30]. It is important to remember that although wearing gloves decreases the risk of spreading pathogens, sanitizing the hands before putting them on decreases the risk of contaminating them. There is a reduction of up to eight times the number of bacteria on the hands of healthcare professionals when wearing gloves. Even so, hand hygiene is indispensable.

A study conducted at the University of Maryland Medical Center (Baltimore), in which hand culture smears were taken from professionals before and after contact with the patient, identified hand contamination after removing the gloves in 4.95% of cases with certain pathogens such as *Pseudomonas aeruginosa* and *Acinetobacter baumannii* being detected in cultures [31].

In a study conducted in an adult ICU of a public university and at a tertiary care hospital in Belo Horizonte, Minas Gerais State, the authors compared the self-reported rate using a questionnaire and the hand hygiene compliance rate through observation. It was possible to perceive a large discrepancy between the self-reported rate (87.9%) and by observation (19%). Professionals pointed out the following difficult factors for not complying to the hand hygiene technique: lack of knowledge, forgetfulness, and distance from sinks, as well as skin irritations caused by the antiseptic products [32].

A study developed in Portugal with 11 registered nurses and 22 licensed practical nurses of a surgical service at a public hospital in Lisbon sought to evaluate the knowledge of nursing professionals about hand hygiene and the factors hindering it. The study was carried out using questionnaires. An understanding of this practice was reported by these professionals. However, 18.2% of registered nurses and 10% of licensed practical nurses pointed out the lack of time and work overload as hindering factors. In addition, it was pointed out that hand hygiene is also performed predominantly after contact with the patient, with 6.34% of licensed practical nurses and 17.70% of registered nurses complying. Only 2.95% of licensed practical nurses and 15.93% of the registered nurses complied to hand hygiene before contact with the patient. Professionals reported seeing hand hygiene as a measure of individual protection and not as a means of protecting the patient, and thus a lack of training was detected [33].

In this study, physical therapists were the professionals who most complied with all the variables observed. A similar result was found by another study carried out at this institution, but the study only assessed professional's compliance to contact precaution measures in adult patients [34].

Regarding the observation unit, although ICU professionals showed greater compliance to contact precautions, hand hygiene was performed incorrectly, putting patients at risk, mainly because these units are the epicenter of multi-drug-resistant infections and they are where many immunosuppressed patients are hospitalized. However, no reports were found in the scientific literature that explore the difference in adherence to contact precaution measures between ICU and on-ward professionals which would provide greater scope for analysis and discussion of the findings. It is suggested that this difference exists due to the proportion of patients assisted, with ICU professionals being responsible for a lower number of patients, and, consequently, fewer changes of PPEs. Thus, more studies are needed to expand knowledge on this theme.

The use of PPEs is just as important as the correct use of equipment. In 2020 the Federal Council of Nursing (COFEN) launched, in the face of the Coronavirus pandemic, a booklet with guidelines establishing how to put on and remove PPEs. With this, precautionary and isolation measures became more evident which has increased the need of further study. [35].

Contact precautions are used to prevent the spread of microorganisms. Failure to carry out training and failure to comply with individual protection recommendations directly influence the risk of developing HAI. Being aware of this, it is important to promote training addressing the entire multidisciplinary team involved in delivering care to patients. Training should be carried out more frequently to guarantee the efficiency of the process, thereby reducing the risks of infections [36].

In view of the failures in adherence to contact precautions and the pandemic that followed this research, more comprehensive and in-depth studies are necessary on adherence to contact precautions. Furthermore, the impact of lack of adherence to these measures on the health of professionals who provide care to patients is a pertinent topic.

The limitation of this study was the availability of nursing undergraduate students. It was impossible to obtain information from them between 10 pm to 7 am on weekends and during bank holidays, times when the number of collaborators is reduced. Furthermore, this study was carried out in a single institution and consequently, it may not be possible to expand the results obtained to other scenarios. However, it is believed that the findings of this investigation are extremely important. From the study of compliance to contact precaution measures, it will be possible to elaborate permanent education actions by service managers, aiming at greater worker protection, reduction of HAIs and, consequently, reduction of hospital costs.

5. Conclusions

Less adherence to hand hygiene was observed before contacting the patient in relation to the other variables observed. Overall, the hand hygiene technique was performed unsatisfactorily. The use of the surgical gown, the correct technique

to remove the surgical gown, the use of gloves, and the correct removal of gloves, corroborate the literature, showing satisfactory results, but there is still a need for improvement.

It is believed that the findings of this research are extremely important as they show possible failures in processes involving the compliance to precaution contact measures by health professionals who assist patients in isolation thereby leading to an increase in HAIs. In this way, the study presents important information for the management of training actions to reduce the risk of HAIs.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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