

Original Article

Influencing factors of hand hygiene in critical sections of a Brazilian hospital

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Abstract

Introduction: The aim of this study was to monitor adherence to hand hygiene by health professionals working in critical sections and to assess the factors that influenced adherence, such as physical structure of the units, use of procedure gloves, employment bond of the worker, and perception of patient safety climate.

Methodology: Observational and correlational study carried out in critical areas of a university hospital in the Midwest region of Brazil.

Results: The overall hand hygiene adherence rate was 46.2% (n = 3,025). Adherence was higher among nurses 59.8% (n = 607) than among nursing technicians ($p < 0.001$), and the section with the greatest adherence was the neonatal Intensive Care Unit 62.9% (n = 947) ($p < 0.001$). Unlike the neonatal unit, in the adult unit the dispensers of alcohol-based handrubs were poorly located, without arms reach, and the taps were manual. In this section, a greater frequency of procedure glove use was also observed, 90.6% (n = 536), as compared to the other sections ($p < 0.001$). Regarding safety climate perception, temporary employees had higher means as compared to regular employees ($p = 0.0375$).

Conclusions: Hand hygiene adherence was affected and/or influenced by the physical structure, use of procedure gloves, work regime, and patient safety climate.

Key words: Hand hygiene; cross infection; patient safety; safety climate.

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Introduction

Increased mortality, increased hospitalization time, increased economic burdens on health systems and potential transmission of multi-resistant microorganisms show that healthcare-associated infections (HAI) have a significant negative impact for patients, professionals and organizations, representing a serious current global public health problem [1].

Intensive Care Units (ICU) are the main site of HAI occurrences, characterized by highly complex care provided to critical patients, with several invasive procedures, a marked severity profile of patients, greater demand for intensive care and antibiotic administration, among others [2,3].

The World Health Organization (WHO), together with other national and international institutions, has developed approaches to improve occupational health

and safety practices among professionals. Among them, the most recent, the “Multimodal Strategy for Improving Hand Hygiene Adherence” [4] has five components: system change, training/ education, performance observation/feedback, reminders in the workplace and institutional security environment [5]. This strategy proved to be successful in improving good practices of hand hygiene adherence [6-9]. However, hand hygiene (HH) adherence has been considerably lower than that recommended worldwide [7,8].

Among the factors that contribute to low HH adherence are structural, organizational and individual components [10]. The infrastructure of health units [5] is often represented by an insufficient number of washbasins, a deficit in the supply of liquid soap and paper towels, absence of HH posters and the availability of alcohol-based handrubs without arms reach of

professionals at the time of care. As for the organizational components that negatively affect on HH adherence, it is worth mentioning the perceived unfavorable patient safety climate [11].

Safety climate positively influences HH adherence as it refers to the involvement of management with patient safety issues [4,11]. Thus, health institutions with a consistently higher safety culture have greater HH adherence than institutions with a more fragile safety culture [11-12].

In this context, the work relationship is an element about the type of employment contract that influences health workers' perception of the patient safety climate, since those who have a temporary employment contract, and therefore, without guarantee of stability, can present positive results concerning safety climate, both because they have been in the institution for less time and because they fear some retaliation in the workplace [13-14].

Another element that hinders HH adherence is the inappropriate use of procedure gloves. These gloves are an part of standard precautionary measures and are therefore mandatory in various clinical situations, in order to avoid contamination of health workers and transmission of microorganisms [6,12]. However, HH must be performed before putting the gloves and after removing them [12].

Based on the above, the objective of this study was to monitor HH adherence by health professionals working in critical sections and to assess the factors that influenced adherence.

Methodology

Study design

This is an observational, analytical and correlational study.

Participants and setting

The research took place in the Adult and Neonatal Intensive Care Units (ICU) and semi-intensive unit of a university hospital, with 124 beds, in the Midwest region of Brazil. The total population of professional nurses, nursing technicians, doctors, medical interns and physical therapists from critical sections of the university hospital was the object of this study (n = 172). That is, all 172 professionals on the work schedule were included. However, only 148 professionals effectively agreed to participate in the study.

The reasons for the 24 professionals not participating were: nine professionals were not found on the days of data collection, eight refused to participate in the study, four were not approached

because they were on vacation, and three were on sick leave.

As pre-established eligibility criteria, the worker should be working at the institution for more than six months, revealing professional experience at the institution, and deliver direct care actions to patients during the data collection period. Professionals who performed exclusively administrative functions and who were learning biosafety measures at the time of data collection were excluded, in order not to influence the proposed objectives.

Variables

The dependent variable of the study was HH adherence. The independent variables were: professional categories, critical sections of activity, type of employment contract regime, use of gloves, structure of the units, and perceived patient safety climate.

Measurement

HH was monitored using the WHO observation form, a tool used worldwide to assess HH adherence by health professionals [15]. This instrument is a checklist that is filled out by the researcher during direct observation. It consists of the five moments recommended by the WHO and the action taken, with three possibilities of filling: 1) rubbing with alcohol; 2) soap and water; 3) not performed. In option 3, the recorded cases were the health professional who did not wash his/her hands, and if he/she did, at the time of observation, was using procedure gloves [15]. Each observation session lasted about 20 minutes [4]. The hand hygiene compliance rate was calculated by the following formula: adherence (%) = number of hand hygiene actions/total number of opportunities × 100, as recommended in the literature [4].

The infrastructure was assessed using the questionnaire provided by WHO [4]. Completed by the researcher, this instrument is a checklist that has 27 items related to physical resources for the sections, such as availability of water, number of beds, number of sinks with water, soap and paper towel available, number of dispensers with alcohol-based handrubs within reach, in conditions of use/refilled, presence/location of illustrative posters about HH, availability of procedure gloves, number of medical professionals, nurses and nursing technicians in each section, participation in HH training, and presence of an audit on HH adherence at the institution [12].

The patient safety climate was measured using a self-administered instrument called Safety Attitudes

Questionnaire (SAQ) Short Form 2006, adapted and validated for the reality of Brazilian hospitals [13] in order to assess the perception of patient safety climate. It has a Likert-type ordinal scale (0-5 points, from strongly disagree to strongly agree) with 41 items divided into six domains: teamwork climate, safety climate, job satisfaction, stress perception, management perception (of section and hospital) and working conditions. The score ranges from 0 to 100 points and scores ≥ 75 are considered as positive [16].

Participants also answered a sociodemographic and professional questionnaire that included the following variables: sex, age, length of professional experience, place of professional experience and participation in hand hygiene training.

Bias

The training for observers included simulation of the HH scenarios represented by the five moments with proper completion of the observation form. This training was planned and conducted by a specialist in the subject. After the training, the researchers observed 10 professionals and 53 HH opportunities simultaneously, during the morning and afternoon shifts. The interobserver agreement and Kappa coefficient were calculated, whose result was 0.90, classified, therefore, as almost perfect agreement [17].

To minimize the Hawthorne effect, health professionals received information and signed an informed consent form six months before the observation. In addition, the observations occurred daily, timed in sessions of 20 minutes at most, during the morning, afternoon and evening shifts and on weekends.

Statistical methods

The processing and statistical analysis of the data were performed with software R. For comparisons of hand hygiene adherence between the variables

“professional categories”, “five moments”, “activity sections”, and “glove use”, the chi-square and z of proportions tests were performed, as well as 95% confidence intervals.

The descriptive analyses of the domains of the Safety Attitudes Questionnaire (SAQ) appear in frequency tables, and the scores of the means and medians of each domain were compared across professionals’ activity sections and type of contract bond through the Kruskal-Wallis and Conover-Iman tests, which allowed visualizing the significance of the data through the calculated medians.

Spearman’s correlation between SAQ scores and hand hygiene adherence in the sections was performed, considering the data did not show normal distribution. To interpret the values of positive and negative correlations, Ajzen and Fishbein’s classification was used, in which values less than 0.30 correspond to weak correlations with little clinical applicability; values below 0.30 and 0.50 are considered moderate correlations and those above 0.50, strong correlations. For all statistical tests, the 0.05 significance level was considered [18].

Ethical considerations

The project was approved by the Research Ethics Committee (REC) under opinion (No. 2.441.333) and received the Certificate of Presentation for Ethical Appreciation (CAAE) (No. 75169317.0.0000.5541), so that all ethical prerogatives of resolution No. 466/2012 of the Brazilian National Health Council were met.

Results

A total of 3,025 HH opportunities were observed. Of these, 1,048 were in the adult ICU, 947 in the neonatal ICU and 1,030 in the semi-intensive care unit. The general HH compliance rate was 46.25%.

As shown in Table 1, the chi-square test rejected the null hypothesis ($p = 0$) of equality for HH adherence

Table 1. Opportunities (Op.) (n = 3,025) actions and hand hygiene adherence according to professional category, and sectors. University Hospital, Midwest, Brazil (2018).

| Variables | Op. | Action | Adherence (%) | CI |
|------------------------------|-------|--------|-------------------|---------------|
| Professional category | | | | |
| Nursing technicians | 1,453 | 510 | 35.1 ¹ | 32.65 - 37.55 |
| Nurses | 607 | 363 | 59.8 | 55.90 - 63.70 |
| Doctors | 412 | 214 | 51.9 | 47.12 - 56.77 |
| Medical interns | 139 | 66 | 47.5 | 39.18 - 55.78 |
| Physical therapists | 414 | 246 | 59.4 | 54.69 - 64.15 |
| Sectors | | | | |
| Adult ICU | 1,048 | 457 | 43.6 | 40.60 - 46.61 |
| Neonatal ICU | 947 | 596 | 62.9 | 59.86 - 66.01 |
| Semi-intensive unit | 1,030 | 346 | 33.6 ¹ | 30.71 - 36.48 |

¹ $p < 0.001$.

Table 2. Structure of the sectors for hand hygiene (HH). University Hospital, Midwest, Brazil (2018).

| Sectors | Beds | Sinks | Sinks with water, soap and paper towels available | Bottles of alcohol-based handrubs available within arms reach | Handrub dispensers available in the unit |
|---------------------|------|-------|---|---|--|
| Adult ICU | 8 | 5 | 2 | 4 | 9 |
| Neonatal ICU | 10 | 4 | 3 | 10 | 13 |
| Semi-intensive unit | 30 | 9 | 6 | 19 | 26 |

between categories, sections and professional moments. Adherence rates by professional categories were 59.8% for nurses, 59.4% for physical therapists, 51.9% for doctors, 47.5% for medical interns and 35.1% for nursing technicians. Nursing technicians had the lowest adherence of all categories, and the difference was statistically significant ($p < 0.001$).

As for physical infrastructure, in the adult ICU there were two sinks with hand-operated taps, one at the entrance to the isolation and one in the common area, next to the first bed. In the sections of the semi-intensive unit, the sinks had hand-operated taps. In the medication preparation room there was no liquid soap in the dispenser, and the disposal containers, which should be activated by foot pedal, were defective, hindering the disposal of paper towels and other materials.

In the adult ICU, there were poorly located dispensers such as behind the bed or devices such as an infusion pump, mechanical respirator, among others. In the three sections investigated, there were no illustrative WHO posters at the points of care to remind professionals about HH adherence. Table 2 shows the data regarding infrastructure.

Of the 3,025 HH opportunities observed, 1,399 HH actions were carried out and 1,626 were not carried out.

Of these actions, in which professionals failed to cleanse their hands, 1,258 (77.36%) were related to the inappropriate use of gloves ($p < 0.001$).

There was a greater frequency of glove use to the detriment of HH absence at the moments “before aseptic procedures” and “after body fluid exposure risk” as compared to the others ($p < 0.001$). Regarding the sections, glove use was significantly higher in the adult ICU unit than in the neonatal and semi-intensive ICUs ($p < 0.001$). Table 3 shows the data regarding the frequency of glove use in the 5 moments of hand hygiene and in the different sections.

Table 4 shows the analysis of SAQ response frequencies, overall and by domains, compared to the type of employment contract. Temporary employees had higher scores than regular employees (hired by public tender) and this difference was significant ($p = 0.0101$). In addition, there was a statistically significant difference in the domains teamwork ($p = 0.0375$), stress perception ($p = 0.0444$), unit management perception ($p = 0.0238$) and hospital management perception ($p = 0.0056$).

The correlation between SAQ domains by the sections investigated and HH adherence was assessed. In the neonatal ICU, there were positive and moderate correlations in the domains teamwork ($r = 0.38$, $p =$

Table 3. Number of opportunities, actions not performed, frequencies, proportions and Confidence Interval (CI) of glove use in the five moments and sectors. University Hospital, Midwest, Brazil (2018).

| Moments | HH Opportunities | Actions not performed | Frequency of glove use | Proportion (%) (CI) |
|---|------------------|-----------------------|------------------------|---------------------------------------|
| Before contact with patient | 959 | 518 | 358 | 69.11 (65.13 - 73.09) |
| Before aseptic procedures | 544 | 370 | 350 | 94.59 ¹ (92.29 - 96.90) |
| After body fluid exposure risk | 523 | 205 | 187 | 91.22 ¹ (87.35 - 95.09) |
| After contact with patient | 681 | 317 | 228 | 71.92 (66.98 - 76.87) |
| After contact with areas close to patient | 318 | 216 | 135 | 62.50 (56.04 - 68.96) |
| Sectors | | | | |
| Adult ICU | 1,048 | 591 | 536 | 90.69 ¹ (88.35 - 93.04) |
| Neonatal ICU | 947 | 351 | 246 | 70.09 (65.30 - 74.88) |
| Semi-intensive unit | 1,030 | 684 | 476 | 69.59 (66.14 - 73.04) |

¹ $p < 0.001$.

0.0114), safety climate ($r = 0.42$, $p = 0.0048$), job satisfaction ($r = 0.37$, $p = 0.0117$) and total score ($r = 0.40$, $p = 0.0091$). In the semi-intensive unit, the correlations were considered positive and moderate with HH adherence in the domain unit management perception ($r = 0.37$, $p = 0.151$) and hospital management perception ($r = 0.40$, $p = 0.0089$).

Discussion

Despite the results of HH adherence being lower than the recommended in all professional categories, moments and sections, we observed that HH adherence is affected, or is influenced by the physical structure of the units, type of employment relationship, perceived patient safety climate, and use of procedure gloves.

Different factors may be related to low HH adherence, among them, health services with inadequate physical structure, including poorly located sinks [6,19,20], inoperative dispensers of alcohol-based handrubs and without arms reach [12,19,20], use of procedure gloves [21], lack of training, among others [12].

The higher rate of HH adherence in the neonatal ICU may have occurred because this unit has better infrastructure, with bottles of alcohol-based handrubs available at hand, as recommended by the WHO, and washbasins with automatic taps. The opposite happened in the semi-intensive unit, which presented inadequate infrastructure for HH, with less accessibility of alcohol-based handrubs in the environment of patient care and consequently less HH adherence.

Difficult access sinks and dispensers, as well as installation in ergonomically incorrect points, can hinder HH adherence [6,22]. Some studies showed that the greater distance between the patient's environment and the sink was associated with decreased HH adherence [19,23].

Each additional meter, which must be covered by the health professional to reach a sink, decreased the likelihood of HH by approximately 10% [6]. Likewise, a study carried out in a pediatric and neonatal ICU in the United Kingdom found that, as the visibility of sinks increased, the number of HH actions also increased [24].

In this sense, it is important to consider that studies that implemented the WHO multimodal strategy and achieved satisfactory adherence rates over time invested mainly in infrastructure, which is the first element of this strategy [8,9,12].

The use of gloves was observed alongside the negative action of HH in the five moments recommended by the WHO. The inappropriate glove use had a great impact on HH adherence and was perceived as one of the factors that can hinder this practice by health professionals, with an emphasis on the indications “before aseptic procedures” and “after body fluid exposure risk”.

The data from the present study showed that procedure gloves were used frequently by professionals before performing aseptic procedures, without previous hand cleansing. The risks resulting from this professional failure can endanger the patient's life, since lack of hand hygiene implies an increase in the transmission of microorganisms from the care environment to the gloves and later these will be in contact with the patient [5,12].

At the time “after body fluid exposure risk,” professionals removed gloves and did not wash their hands immediately after removal, as recommended by the WHO, and the same situation was observed in other countries in previous studies.

It is noteworthy that in addition to the risks of HAI transmission to patients, one of the major risks associated with low HH adherence is the contamination

Table 4. Distribution of medians, means and standard deviations (SD) of the Safety Attitudes Questionnaire (SAQ) domains and comparison with work regimes (n = 148). University Hospital, Midwest, Brazil (2018).

| SAQ Domains | Work regime | | | | | |
|--------------------------------|--------------------|---------------|--------------------|---------------|--------------------|---------------|
| | Regular employment | | Temporary contract | | No employment bond | |
| | Median | Mean (SD) | Median | Mean (SD) | Median | Mean (SD) |
| Teamwork climate | 62.50 a | 61.84 (15.59) | 70.83 b | 67.38 (14.12) | 70.83 b | 70.09 (13.83) |
| Safety climate | 50.00 a | 51.00 (14.06) | 57.14 a | 55.91 (14.61) | 60.71 a | 59.24 (12.37) |
| Job satisfaction | 67.50 a | 67.03 (16.84) | 75.00 a | 72.02 (17.61) | 75.00 a | 75.00 (18.87) |
| Stress perception | 68.75 a | 66.79 (16.75) | 75.00 a | 69.94 (17.78) | 87.50 b | 80.51 (18.47) |
| Unit management perception | 41.66 a | 43.09 (18.28) | 45.83 a | 48.31 (14.96) | 54.16 b | 56.37 (13.43) |
| Hospital management perception | 39.58 a | 39.58 (16.53) | 50.00 b | 48.52 (12.17) | 50.00 b | 50.98 (16.23) |
| Work conditions | 45.83 a | 42.70 (21.97) | 50.00 b | 51.17 (20.62) | 58.33 a | 53.43 (20.63) |
| Total SAQ | 55.79 a | 55.20 (12.94) | 60.97 b | 61.17 (10.83) | 64.63 b | 65.53 (9.54) |

a, b: medians followed by different lowercase letters, between the columns, differ statistically from each other, at the level of 5% of significance, by the Kruskal-Wallis and Conover-Iman test ($p < 0.05$).

of glove boxes, making them an environmental reservoir of pathogens [21,24,25].

In our study, the section with the highest glove use adherence was the adult ICU (91%), a result that may be related to the low HH adherence found in this unit (44%). These findings are in line with other studies that attributed the use of gloves as one of the main risk factors for non-compliance with hand hygiene [21,25,26].

Regarding the perceived patient safety climate, SAQ scores were low for all domains evaluated, corroborating research carried out in other Brazilian states and abroad [13,27,28].

It is worth highlighting the lowest scores perceived by professionals in the domain “Unit and hospital management perception.” This domain is a fundamental factor for patient safety, since it reflects the professional’s agreement regarding the actions and involvement of the management or administration of the hospital and the units. Thus, creating a favorable atmosphere in the work environment, conducive to an open dialogue about errors, and a collaborative rather than punitive environment are some of the main actions of hospital and unit management that can have a positive impact on patient safety [13,28].

The perception of a safety climate varied according to the different work regimes. Medical interns and temporary professionals had higher means than regular professionals hired by tender ($p < 0.05$). This finding may be associated with these professionals’ shorter service time at the institution, since the opposite situation was observed in another similar study, in which the professionals with more service time at the institution had a better perception of individual and collective skills regarding the hospital’s commitment with safety issues [13].

Moreover, temporary professionals have little stability due to the adopted work regime, and they tend to have more positive responses to the safety climate because they fear retaliation in the work environment, although confidentiality of the data was highlighted several times during the study. Similar data were found in the research carried out by De Carvalho *et al.* [13], with higher scores for temporary employees than for regular ones.

It is worth mentioning that the employment relationship can influence when answering questionnaires of an organizational nature. Regular professionals hired by public tender have job security guaranteed by Brazilian labor laws, have more time in the institution and for these reasons can better perceive

the problems experienced and are less afraid to expose the difficulties encountered.

Regarding the correlation between SAQ domains in sections with HH adherence, the positive and moderate correlations found in the neonatal and semi-intensive ICU units showed that as the perception of patient safety climate increases, HH adherence responds positively, which reinforces the findings about the importance of safety climate perception by professionals in increasing HH adherence in hospitals and the respective reduction of HAIs.

This research had limitations. One of them was data collection performed in a single institution, which reduces the number of observations and the representativeness of the professionals. Another limiting factor in was the Hawthorne effect, which can occur during observational studies [29]. However, several observation sessions were carried out at different times of the day to minimize this effect.

Conclusions

Low HH adherence is influenced by infrastructure and glove use. Such data reveal the need for investment in adequate infrastructure, since greater access to washbasins and availability of alcohol-based handrubs tend to favor increased HH adherence.

Regarding safety climate perception, the low scores in all domains and units evaluated showed an alert situation for the institution with an urgent need to implement actions that promote a favorable patient safety climate, since high safety climate perceptions are associated with adopting safe behaviors, improving communication, conducting training with a positive impact, reducing adverse events, among others, thus contributing to safe practices in patient care.

In line with the results of this study, health institutions and their managers are expected to realize the importance of hand hygiene and at the same time seek to identify gaps and plan improvement actions based on the multimodal strategy.

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Authors’ Contributions

Conceptualization, M.V., T.B., and A.S. Methodology, J.B., W.A., M.R., A.F. Data collection, T.B., M.V., Formal analysis, M.V., T.B., J.B. Writing—original draft preparation, M.V., T.B., A.S., D.A., A.F. Writing—review and editing, M.V., T.B., A.S. Project administration, T.B.,

A.S. All authors have read and agreed to the published version of the manuscript.

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