

High-touch surfaces disinfection compliance in a COVID-19 intensive care unit



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**Highlights**

- Fluorescent marker as an option for high-touch surface disinfection validation.
- The educational feedback increased the adherence to surfaces disinfection.
- Implementation science can enhance adherence to infection prevention measures.

**High-touch surfaces disinfection compliance in a COVID-19 intensive care unit**

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**Abstract**

Environmental cleaning and disinfection are fundamental healthcare-associated infection prevention measures. This study aimed to evaluate the disinfection compliance of high-touch surfaces in a COVID-19-only intensive care unit, using a fluorescent marker. It was divided into three phases, baseline assessment, educational feedback, and post feedback. Disinfection compliance improved significantly from the first to the third phase, 14.3% to 51.4% ( $p < 0.001$ ), respectively.

**Keywords**

Disinfection; Guideline Adherence; Formative Feedback; Cross Infection; Implementation Science; COVID-19.

**Background**

The COVID-19 pandemic directly impacted healthcare-associated infection (HAI) prevention efforts. Intensive care units (ICU) experienced increased strain, related to overcrowding, staff deficits, untrained staff, burnout syndrome, shortness of equipment and supplies. Further there was a lack of HAI surveillance, like process measure data collection and feedback to units, plus low compliance on personal protective equipment. These combined factors may increase cross- transmission.<sup>1</sup>

In the last quarter of 2020, a report from the National Healthcare Safety Network evidenced a significant increase in many HAIs as compared with 2019. Increased HAIs included 47% for central–line–associated bloodstream infections, 18% for catheter-associated urinary tract infections, 44.8% for ventilator-associated events, and 33.8% for methicillin-resistant *Staphylococcus aureus*.<sup>2</sup> While data from low- and middle-income countries are scarce, what is available also suggests higher rates of HAIs in these settings in non-COVID-19 patients.<sup>3</sup>

Environmental cleaning and disinfection are fundamental HAI prevention measures to reduce the spread of microorganisms, such as multidrug resistant pathogens, and requires training, monitoring, auditing, and feedback. The World Health Organization recommends surfaces cleaning of areas occupied by COVID-19 inpatients at least twice daily.<sup>4</sup>

Previous researchers have found that coronavirus can remain viable on surfaces, although evidence of environmental transmission is limited.<sup>5</sup> Additionally, studies that evaluate compliance with disinfection protocols in patient care areas with COVID-19 inpatients are scarce.

This study aimed to evaluate the compliance of high-touch surface disinfection in an exclusively COVID-19 ICU, using a fluorescent marker for validation, and as a tool to staff feedback in the context of an ICU team-lead implementation process of an HAI prevention project.

## Methods

This study was approved by the Ethics Committee and was conducted from May to July 2021 in the 35- bed ICU of a teaching hospital in Brazil. Throughout the study, the ICU exclusively assisted patients with COVID-19 infections, confirmed with real-time PCR (RT-PCR).

In March 2021, the ICU team initiated a program aiming to reduce HAIs, that enabled the development this compliance study. According to the institution's protocol, disinfection of patients' environmental surfaces should be conducted three times per day. This study was divided into three phases: baseline assessment (May 2021), educational feedback (June 2021) and post feedback (July 2021).

Prior to the baseline assessment a Plan-Do-Study-Act cycle was applied to define the fluorescent marker, to choose the ten high-touch surfaces, and the best way to apply the product to the surfaces (Supplementary material). Ten high-touch surfaces were included: upper right bed rail, lower right bed rail, upper left bed rail, lower left bed rail, infusion support, infusion pump, vital sign monitor, mechanical ventilator, medication cart and footboard. Compliance with disinfection was defined by the presence of eight or more surfaces properly cleaned.<sup>6</sup>

To evaluate disinfection compliance, a trained professional applied the fluorescent marker Glo Germ<sup>TM</sup> to all listed surfaces with a cotton swab at the beginning of the shift. All 35 beds were included in this phase. The ICU staff had no knowledge of the process as this product can only be detected with ultraviolet light. At the end of the shift, the surfaces were assessed using ultraviolet light. Each surface was considered disinfected if the fluorescent marker was totally removed or reduced significantly.

The data were collected using an electronic form and were used to establish the baseline compliance rate. No feedback was provided to the ICU team during this phase.

In the feedback phase the Infection Control team shared the baseline disinfection compliance rates and pictures of validation process with the ICU team through demonstration classes. Group discussion was also encouraged. In addition, the local prevention HAI project members, named champions, shared the results of the disinfection assessment with the nursing team in real time, demonstrating the cleaning of each surface while using ultraviolet light to immediately correct ineffective cleaning.

In the post feedback phase, the environmental disinfection of all 35-beds was reevaluated using the same approach. During this phase, real time feedback was continued to reinforce the education initiated in the feedback phase.

A descriptive analysis was conducted. To compare the disinfection compliance rates between the first and third phases the Student's *t*-test was used.

## Results

Throughout the study, 700 disinfection surfaces of 35 inpatient rooms were analyzed, 350 in the baseline assessment and 350 in the post feedback phase. In figure 1, the selected high-touch surface spots are marked. The disinfection compliance in the first phase was 14.3% and in the post feedback phase was significantly higher 51.4% ( $p < 0.001$ ). Disinfection compliance significantly improved, except for the mechanical ventilator disinfection (37.1% to 44.1%,  $p = 0.626$ ). The disinfection of the medication cart was appropriate in both phases. The disinfection compliance by specific surface is shown in Table 1.

## Discussion

Systematic cleaning and disinfecting practices are key in controlling the spread of pathogens that can persist on uncleaned surfaces for several weeks. This research evaluated the compliance with surface disinfection in ICU rooms exclusively designated to COVID-19 inpatients.

We showed an overall low compliance rate, 14.3%, at baseline for disinfection, with significant improvement after the educational feedback, 51.4% ( $p=0.0009$ ) revealing the importance of this strategy. A Chinese study investigated the environmental virus contamination through RT-PCR and the effect of terminal disinfection in areas of patients with COVID-19. The rate of contamination of the high-touch surfaces was 22.58% (7/31); after the disinfection, 24 surfaces were sampled, and no virus contamination was detected.<sup>7</sup>

Studies unrelated to the COVID-19 pandemic analyzed the compliance with cleaning and disinfection using different methods of validation; in addition, some have evaluated the impact of educational interventions. One study compared the adherence to disinfection protocols for standard precautions, contact precautions and enteric isolation rooms using a fluorescent marker, the adherence rates were 83%, 88%, and 73%, respectively.<sup>8</sup>

A quality improvement project by means of a fluorescent marker showed a constant increase in adherence to surface cleaning in three phases after educational interventions with values of 20%, 49%, and 82% ( $p=0.007$ ).<sup>9</sup>

A multicenter study of ICUs evaluated the efficacy of terminal cleaning and disinfection by measuring Adenosine triphosphate (ATP) levels, colony-forming units, and reflective surface marker removal. The educational intervention was composed of ATP measurements and offered feedback based on the quality of the surface disinfection and cleaning processes.<sup>10</sup>

In the present study, except for the mechanical ventilator disinfection, the overall disinfection compliance significantly improved, probably because the ventilators are minimally manipulated by the nursing team. Usually, ventilator parameters are managed by the physiotherapy or medical team. This contrasts with the disinfection of the medication cart (mainly used by the nursing team), which remained appropriate in both phases.

The current study highlighted the importance of combining validation of the disinfection process with real time educational feedback to increase disinfection compliance.

Additionally, this study contributed to quality health improvement in the ICU by systematically incorporating all processes.

#### **Conflict of interest**

All authors report no conflicts of interest relevant to this article.

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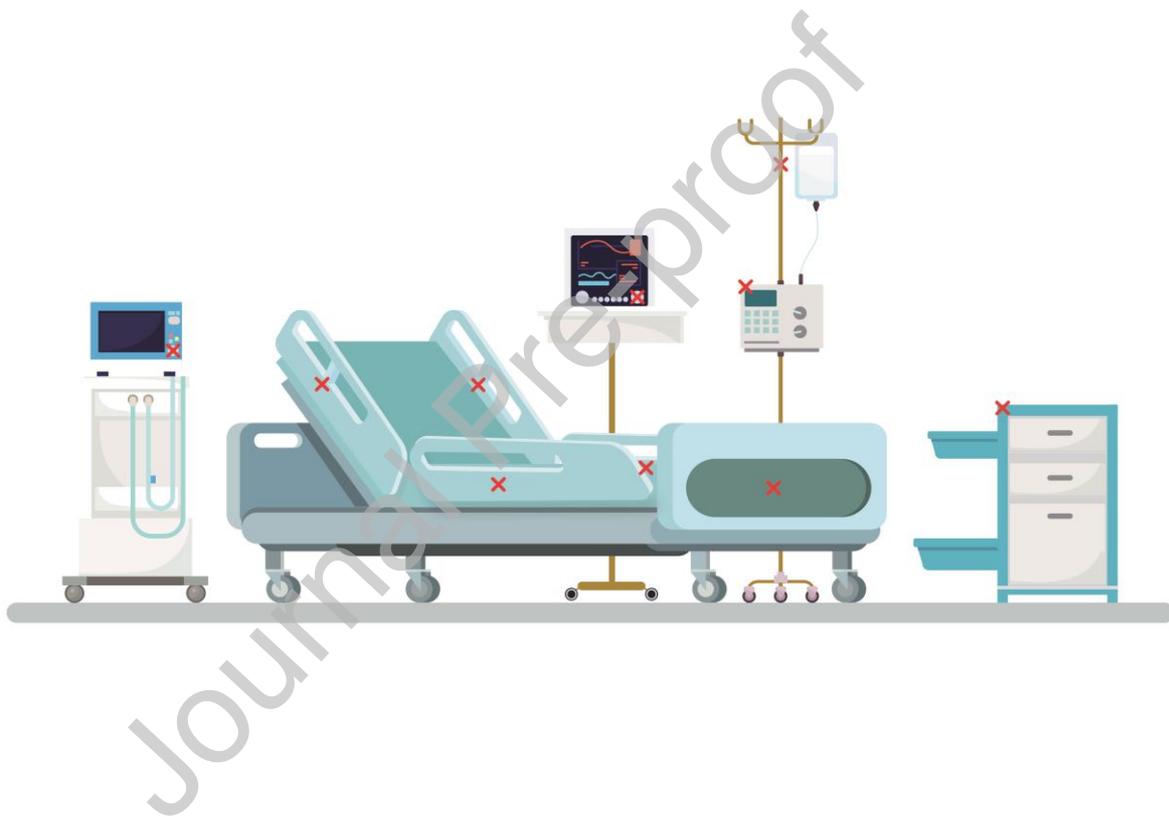
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Figure 1- Selected high-touch surface spots



**Table 1.** High-touch surface disinfection compliance in a COVID-19 intensive care unit

Surface	Baseline assessment compliance		Post feedback compliance		P Value
	n=350 surfaces (35 patients' environment)		n=350 surfaces (35 patients' environment)		
	Compliance		Compliance		
	n	%	n	%	
Upper right bed rail	13	37.1	25	71.4	0.004
Lower right bed rail	11	31.4	28	80.0	0.037
Upper left bed rail	11	31.4	21	60.0	0.016
Lower left bed rail	14	40.0	23	65.7	0.031
Infusion support	13	37.1	26	74.3	0.001
Infusion pump	7	20.0	23	65.7	<0.001
Vital sign monitor	8	22.9	24	68.6	<0.001
Mechanical ventilator	13	37.1	15	44.1	0.626
Medication cart	30	85.7	33	94.3	0.232
Foot board	10	28.6	21	60.0	0.008
Disinfection compliance*	5	14.3	18	51.4	<0.001

\* Compliance accomplished when eight or more surfaces were correctly disinfected