

Assessment of Nurses' Practices in Cleaning Non-Critical Medical Equipment During the COVID-19 Pandemic: A Cross-Sectional Study at Debre Tabor Comprehensive Specialized Hospital

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Received: 29 April 2025; Revised: 12 September 2025; Accepted: 14 September 2025

ABSTRACT

This study aimed to evaluate the cleaning practices of non-critical medical equipment (NCME) among nurses working at Debre Tabor Comprehensive Specialized Hospital (DTCSH) in north-central Ethiopia during the COVID-19 pandemic. A facility-based cross-sectional study was carried out at Debre Tabor Comprehensive Specialized Hospital (DTCSH), Ethiopia, from July 5 to August 5, 2020. The study was conducted in inpatient and outpatient units of the hospital. The study involved observations of 76 randomly chosen staff nurses, alongside interviews with 6 head nurses. Only 1.3% to 5.3% of nurses cleaned stethoscopes, thermometers, pulse oximeters, and glucometers immediately after patient use. None of the nurses reported cleaning blood pressure devices before or after measuring a patient's blood pressure, nor glucometers prior to assessing blood glucose levels. Head nurses identified the primary barriers to proper cleaning practices as a shortage of disinfecting materials and insufficient training on infection prevention. The cleaning practices of non-critical medical equipment (NCME) among nurses were found to be very low. Therefore, ensuring an adequate supply of cleaning materials is essential, along with providing nurses with targeted training on infection prevention.

Keywords: Nurse, Cleaning, Non-critical medical equipment, COVID-19

How to Cite This Article: Mwinyi J, Salum K, Rashid A. Assessment of Nurses' Practices in Cleaning Non-Critical Medical Equipment During the COVID-19 Pandemic: A Cross-Sectional Study at Debre Tabor Comprehensive Specialized Hospital. *Interdiscip Res Med Sci Spec.* 2025;5(2):36-42. <https://doi.org/10.51847/zVh4v5LUP2>

Introduction

The coronavirus disease-2019 (COVID-19), caused by the novel severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), remains a significant global health threat. The virus was first identified in patients with pneumonia of unknown etiology in Wuhan, China, at the end of 2019 [1]. COVID-19 is highly contagious, spreading rapidly from person to person. By June 28, 2020, approximately 9,851,287 cases and 500,882 deaths had been reported globally across 216 countries [2], with Ethiopia reporting 5,689 cases and 98 deaths [3].

Nosocomial COVID-19 infections have been reported at high rates, often associated with elevated mortality [4]. Health care workers (HCWs) are particularly at risk; by July 2020, the World Health Organization (WHO) reported that approximately 10% of all global COVID-19 cases, including over 10,000 cases in Africa, were among HCWs. Major contributing factors include inadequate personal protective equipment (PPE) and poor adherence to infection prevention protocols [5].

COVID-19 is primarily transmitted through close contact with infected individuals; however, indirect transmission via contaminated inanimate surfaces is also possible [6, 7]. This indirect route is especially concerning in health care settings, where environments are continually exposed to pathogenic and resistant microorganisms, including SARS-CoV-2. Previous studies have isolated various microorganisms from the air, patient care items, patient charts, computer peripherals, HCWs' mobile devices, and other equipment within health

care institutions [8–11]. A study in Wuhan further detected SARS-CoV-2 on surfaces and in the surrounding air of both intensive care units and general wards housing COVID-19 patients [7].

Medical equipment that frequently contacts patients and HCWs is particularly susceptible to microbial colonization. Non-critical medical equipment (NCME), such as stethoscopes, blood pressure apparatuses, thermometers, oxygen flow meters, pulse oximeters, and glucometers, may carry pathogenic microorganisms if not properly cleaned [12]. Studies in India reported bacterial colonization in 50.8% to 60% of stethoscopes [13, 14], with thermometers and blood pressure devices also demonstrating microbial contamination [15, 16]. These devices may similarly harbor SARS-CoV-2 [17].

The Centers for Disease Control and Prevention (CDC) recommends low-level disinfection for NCME, to be performed before and after patient contact, once daily, or at least when visibly soiled [18]. During the COVID-19 pandemic, the use of approved disinfectants on both medical equipment and frequently touched surfaces is strongly recommended [19]. Biocidal agents have demonstrated efficacy against SARS-CoV-2 [20], and extending the cleaning frequency of patient care equipment has been suggested as an important measure to reduce environmental contamination and nosocomial infections [21].

Despite these guidelines, HCWs often fail to consistently implement preventive measures, allowing medical equipment to become colonized and potentially contribute to nosocomial infections [22]. Accordingly, this study aimed to assess nurses' cleaning practices of NCME and provide evidence-based recommendations.

Materials and Methods

Study design and setting

A facility-based cross-sectional study was conducted from July 5 to August 5, 2020, at Debre Tabor Comprehensive Specialized Hospital (DTCSH), located 665 km north of Addis Ababa in north-central Ethiopia. The hospital employs 152 nurses who work across various inpatient and outpatient units.

Eligibility criteria

The study targeted nurses present at DTCSH throughout the data collection window, excluding any staff who were on maternity, annual, or sick leave.

Sample size determination and sampling technique

The study included all nurses actively working across various hospital units during the data collection period, along with six head nurses who participated in interviews.

Data collection instrument and procedure

Quantitative data were collected using a structured observational checklist and an interview guide adapted from CDC recommendations for instrument processing [18]. With approval from the administrative offices of DTCSH, four MSc-qualified nurses conducted covert observations of staff nurses' practices. Following completion of the observations, the principal investigator conducted in-depth interviews with the head nurses."

Study variables

The study variables included nurses' cleaning practices of non-critical medical equipment (NCME), participants' gender, their hospital unit, and the work shift during which data were collected."

Data processing and analysis

After collection, the data were organized, coded, and uploaded into Epidata Manager 4.6, then transferred to SPSS version 26 for statistical analysis. Descriptive methods were applied to outline the characteristics of participants and their cleaning practices. For the qualitative data, interview recordings were first transcribed in Amharic, translated into English, and subsequently subjected to thematic analysis.

Operational definitions

Non-critical medical equipment (NCME) comprises devices that either only touch intact skin or have no direct patient contact [18]. For the purpose of this study, NCME included stethoscopes, blood pressure devices, thermometers, pulse oximeters, and glucometers.

A practice was considered 'performed' if a nurse used an approved disinfectant to clean the NCME before or after patient contact. Conversely, it was considered 'not performed' if the nurse failed to disinfect the equipment with approved agents at these times.

Ethics approval

Ethical approval for the study was granted by the College of Health Sciences at Debre Tabor University. Following this, permission was secured from the hospital administration and the heads of various units. Informed consent for participation in the interviews was obtained from the head nurses.

Results and Discussion

Demographic characteristics

The cleaning practices of non-critical medical equipment (NCME) were observed among 137 nurses at DTCSH, yielding a response rate of 90.1%. Of the participants, 66.4% were female. Observations were conducted predominantly in inpatient units (75.2%), with 67.1% occurring during the day shift (**Table 1**).

Table 1. Distribution of observation shifts, departments, and gender of participants at DTCSH, Debre Tabor, Ethiopia, July 5–August 5, 2020 (N = 137).

| Characteristic | Number | Percent (%) |
|-----------------------|--------|-------------|
| Gender | | |
| Male | 46 | 33.6 |
| Female | 91 | 66.4 |
| Working unit | | |
| Outpatient department | 34 | 24.8 |
| Inpatient department | 103 | 75.2 |
| Working shift | | |
| Day shift | 74 | 67.1* |
| Night shift | 36 | 32.9* |

Distributions of nurse's cleaning practice of NCME

During the study, a total of 1,104 opportunities to observe the cleaning of non-critical medical equipment (NCME) were recorded through covert observation. This approach was employed to minimize social desirability bias and obtain a more accurate assessment of nurses' cleaning practices. Among the 137 nurses observed in both inpatient and outpatient units, approximately 274 opportunities each were recorded for cleaning stethoscopes, thermometers, and blood pressure apparatuses before or after patient contact.

Pulse oximeters and glucometers were not available in all units, limiting observations for these devices to only 176 opportunities for pulse oximeter cleaning among 88 nurses, and 106 opportunities for glucometer cleaning among 53 nurses, before or after use. As shown in **Table 2**, the majority of nurses did not routinely disinfect NCME before or after patient interactions. The highest observed compliance was for cleaning thermometers after patient temperature measurement, which occurred in only 5.1% of cases. No nurses were observed cleaning blood pressure apparatuses before or after measuring patients' blood pressure, nor glucometers before measuring blood glucose. Additionally, none of the nurses cleaned any NCME both before and after patient encounters. Overall, only 21 out of 1,104 cleaning opportunities (1.9%) were performed. Alcohol-based sanitizers were used in 18 of these instances (85.7%), while the remaining three practices involved the use of 70% alcohol (**Table 2**).

Table 2. Observed cleaning practices of non-critical medical equipment by nurses at DTCSH, Debre Tabor, Ethiopia, July 5–August 5, 2020.

| Equipment | Timing | Practiced n (%) | Not Practiced n (%) | Total Opportunities |
|-------------|------------------------------|-----------------|---------------------|---------------------|
| Stethoscope | Before patient examination | 4 (2.9) | 133 (97.1) | 137 |
| | After patient examination | 2 (1.5) | 135 (98.5) | 137 |
| Thermometer | Before measuring temperature | 4 (2.9) | 133 (97.1) | 137 |

| | | | | |
|---------------------|-----------------------------------|----------|-------------|------|
| | After measuring temperature | 7 (5.1) | 130 (94.9) | 137 |
| Blood pressure cuff | Before checking BP | 0 (0.0) | 137 (100.0) | 137 |
| | After checking BP | 0 (0.0) | 137 (100.0) | 137 |
| Pulse oximeter | Before measuring SpO ₂ | 2 (2.3) | 86 (97.7) | 88 |
| | After measuring SpO ₂ | 1 (1.1) | 87 (98.9) | 88 |
| Glucometer | Before checking blood glucose | 0 (0.0) | 53 (100.0) | 53 |
| | After checking blood glucose | 1 (1.9) | 52 (98.1) | 53 |
| Total | — | 21 (1.9) | 1083 (98.1) | 1104 |

Head nurses' response of availability of supplies, cleaning behaviors, and barriers to clean NCME

The qualitative findings were organized into three main themes: availability of supplies, perceptions of NCME cleaning practices within units, and barriers to proper NCME cleaning. These themes were consistently emphasized by head nurses during the interviews.

Head nurses reported that NCME were insufficiently available in most units, typically ranging from one to three stethoscopes, blood pressure cuffs, thermometers, and pulse oximeters per unit. As a result, nurses were required to share the same equipment when assessing multiple patients. All head nurses indicated that essential supplies for cleaning NCME and adhering to other infection prevention measures were inadequate. They further noted that nurses' practices in their units fell below standard, exposing both themselves and patients to potential health risks. One participant commented:

"Personal protective equipment and materials needed to clean reusable equipment are not available. The problem is even worse during this pandemic. Clean gloves are lacking; since surgical gloves are expensive, nurses often use the same pair to check vital signs of multiple patients. Alcohol and sanitizers are insufficient, and in some cases, normal saline is being used to clean intravenous cannulation sites."

All head nurses perceived nurses' NCME cleaning practices as insufficient. Inpatient unit supervisors highlighted that devices used for vital signs are applied to all admitted patients at least twice daily, yet nurses rarely disinfect the equipment between patients. One head nurse stated:

"...disinfecting this equipment is essential, but observing a nurse clean it before or after patient assessment is uncommon. We even share the same stethoscope without cleaning the earpieces. This practice spreads microorganisms not only among patients but also among staff."

The primary barriers identified for inadequate NCME cleaning were shortages of supplies, lack of training, and negligence. While the scarcity of cleaning solutions was the most pressing issue, head nurses also emphasized that limited infection prevention training and low commitment to proper equipment hygiene contributed to unsafe NCME practices. One head nurse described the supply situation:

"There is a severe shortage of cleaning solutions for this equipment. Vital sign and other patient care devices are insufficient. For example, in this large 42-bed ward, we have only two stethoscopes, two blood pressure cuffs, one digital thermometer, one pulse oximeter, and one glucometer. This equipment is shared not only among patients but also among nurses. Under these circumstances, it is difficult to fault nurses for their inadequate care of the equipment."

Proper disinfection of non-critical medical equipment (NCME) between patient uses is frequently overlooked, leaving these devices vulnerable to colonization by pathogenic microorganisms and contributing to health care-associated infections [11, 22, 23]. Consistently, this study revealed poor cleaning practices among nurses at DTCSH for stethoscopes, thermometers, blood pressure cuffs, pulse oximeters, and glucometers.

Out of 274 stethoscope cleaning opportunities (137 before and 137 after patient contact), only six were observed to be practiced. Cleaning was performed in 2.9% of opportunities before and 1.5% after patient contact. These findings align with a previous study reporting 2.8% compliance both before and after patient interactions [22]. In contrast, a study in southwest Ethiopia reported that 22.5% of health care workers disinfected stethoscopes, though only 6.45% did so consistently. The discrepancy may be attributed to the self-administered data collection method used in that study [15]. Stethoscopes are highly susceptible to microbial colonization, which can lead to nosocomial infections [24], and have been suggested as potential vectors for COVID-19 transmission either through surface contamination or close patient contact [25]. While electronic stethoscopes, which allow physical distancing and use of personal protective equipment, are less widely available, proper care is essential for both electronic and acoustic types [26].

Thermometers were disinfected by 2.9% of nurses before and 5.1% after measuring body temperature. These rates fall far below recommended standards and pose significant contamination risks [18]. A prior study in Ethiopia found that 20.4% of physicians disinfected non-infrared thermometers after patient use; the higher figure may be explained by the online survey methodology and the participants being physicians, who may overreport favorable practices compared to covert observational methods [27].

Glucometers are also prone to contamination during blood glucose testing, and bacterial colonization can occur even on unused test strips [28]. Despite this, only 1.9% of nurses in the current study disinfected glucometers after use. Blood pressure cuffs were not disinfected by any of the nurses before or after measurement. While continuous disinfection may not be required for every encounter, the observed total lack of cleaning indicates a clear gap in practice [18].

Head nurses corroborated these observations, reporting inadequate cleaning of reusable NCME in their units. Such insufficient cleaning contributes to microbial contamination, including drug-resistant pathogens, on these devices [29].

The main barriers identified by head nurses included shortages of cleaning supplies and NCME, which force nurses to share equipment without proper disinfection. The scarcity of materials needed for COVID-19 prevention and control intensified this issue during the pandemic [30]. Additionally, lack of training was noted as a contributing factor. Training is known to improve knowledge and adherence to infection prevention protocols [31] and may help nurses optimize NCME cleaning practices even with limited resources.

Limitations

Nurses' cleaning practices of NCME were observed on a single occasion, and repeated observations could provide a more comprehensive understanding of their routine practices. This study did not assess the physical condition or microbial contamination of the equipment. Future research should consider repeated observations and incorporate physical and laboratory evaluations of NCME. Additionally, the findings of this study are limited in generalizability and apply only to the specific group of nurses included.

Conclusion

The cleaning practices of routinely used non-critical medical equipment among nurses were extremely low, with certain practices entirely neglected. Head nurses identified the main barriers as insufficient disinfecting materials, lack of infection prevention training, and negligence. Inadequate cleaning of NCME poses a significant risk to patient safety. To address this, nurses should receive targeted training on the proper care of NCME and broader infection control measures, and adequate supplies for cleaning these devices must be ensured.

Acknowledgments: We would like to thank Debre Tabor comprehensive specialized hospital staff, data collectors, and supervisors whose assistance was invaluable to the completion of this study.

Conflict of Interest: None

Financial Support: None

Ethics Statement: None

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