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A Survey of Adherence to Guidelines to Prevent Healthcare-Associated Infections in Iranian Intensive Care Units

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Abstract

Background: Healthcare-associated infections (HAIs) are acquired by patients while receiving care. The highest incidence of HAIs has been documented in admissions to intensive care units. Adherence to evidence-based practices is the most important step for preventing HAIs.

Objectives: To determine the rate of adherence to evidence-based post-insertion recommended care practices after admission into the intensive care unit for the following devices: central line catheter, indwelling urinary catheter, and mechanical ventilator.

Patients and Methods: A structured observational cross-sectional research design was used. Data were collected using a checklist and a self-report questionnaire. The minimum sample size required for this study was 276 post-insertion care episodes, and 332 episodes were observed. The ANOVA test was used to identify any significant differences among the mean scores of the three devices.

Results: Overall observed adherence rates were 18.3%, 59.1%, and 43.1% for central line catheters, indwelling urinary catheter, and mechanical ventilator, respectively. Of the observed episodes of device care, only in 9.4% of the episodes was regular oral care performed for patients on mechanical ventilators and only in 19.3% of the episodes were indwelling urinary catheters properly secure after insertion. More so, in none (0.0%) of the episodes was the central line catheter hub disinfected before being accessed.

Conclusions: Evidence-based post-insertion recommended care practices were not consistently and uniformly implemented in the intensive care units. Establishment of a program for the surveillance of adherence to recommended guidelines is required for improving compliance by health professionals and the quality of preventive care.

Keywords: Catheter-Related Infections, Ventilator-Associated Pneumonia, Evidence-Based Practice, Clinical Practice Guideline

1. Background

Healthcare-associated infections (HAIs), also known as nosocomial infections or hospital-acquired infections, are infections acquired by a patient during the process of receiving care in a healthcare facility and which were not present or incubating at the time of admission (1). HAIs are a worldwide phenomenon, a public health burden, and a threat to patient safety that pervades all healthcare facilities both in developed and developing countries (2, 3). At any given time, it is estimated that over 1.4 million people worldwide suffer from HAIs (4). They are often associated with increased morbidity, mortality, length of stay, and healthcare cost (5).

The intensive care unit (ICU) has been documented to have the highest incidences of HAIs (6). Various factors account for these high incidences, among which is the use of invasive medical devices such as central line catheters (CVC), indwelling urinary catheters (IUC), and mechanical ventilators (MV), as well as poor adherence by staff to evidence-based infection prevention recommended care procedures (7, 8). The use of invasive devices has become the primary method of care for ICU patients, but their use breaches the body's normal defense mechanisms a risk factor for acquiring an HAI (9). More than 75% of all HAIs accounted for are device-acquired healthcare-associated infections (DA-HAIs): central line-associated blood stream infection (CLABSI), ventilator-associated pneumonia (VAP), and catheter-associated urinary tract infection (CAUTI) (10). Nonetheless, like many other infections, DA-HAIs are considered preventable with proper infection control programs such as the adoption of clinical practice guidelines and the adherence to evidence-based recommendations (11).

However, varying levels of evidence exist in relation to the efficacy of infection control procedures involving CVC, IUC, and MV care. The center for disease control and prevention (CDC) in the US is a legendary infection control body that has been influential in reviewing evidence for effective infection prevention measures in many areas including DA-HAIs. In collaboration with a multidisciplinary group of healthcare professionals, the CDC has published evidence-based guidelines for the prevention of VAP, CAUTI, and CLABSI. These guidelines have been adopted by many hospitals in the USA and other countries and have been proven to effectively reduce DA-HAI rates (12).

Iran has a population of more than 70 million people (13) and a recorded 6 million hospitalizations annually (14). As of 2012, the HAI prevalence rate for Iran was 0.89% with CAUTI, VAP, and CLABSI rates of 26.5% , 24.4% , and 15.5% , respectively (15). The impacts of HAIs in Iranian hospitals range from increased patient medical costs to prolonged hospitalization of up to 22 days (1).

To date, despite the numerous point-prevalent survey studies that have been carried out in Iran on HAIs, nothing was identified in the literature on the contribution of the practitioners' care practices to the infection rates. The surveillance of infection rate is not designed to establish causality, but to flag the magnitude of the HAIs. However, knowledge of causality can be established from the practices of the practitioners. The adherence rate to evidence-based prevention recommendations would offer a view of the practices of the healthcare staff as well as provide information to enhance strategies for infection prevention.

2. Objectives

The aim of this study was to investigate the adherence rate of nurses and physicians in the adult ICUs of the Imam Khomeini hospital complex to evidence-based post-insertion recommended care practices for CVC, IUC, and MV based on the clinical practice guidelines provided by the CDC and society of healthcare epidemiology America (SHEA).

3. Patients and Methods

3.1. Data

3.1.1. Study Design

A structured observational cross-sectional design was implemented to survey five adult ICUs in the Imam Khomeini hospital complex.

3.1.2. Setting and Sampling

Research was done in the Imam Khomeini hospital complex. It is a university teaching and general hospital made up of three medical centers. The five ICUs that participated in this study were: the general ICU, the open heart ICU, the neurology ICU, the emergency ICU, and the cancer surgical ICU. Together, these five ICUs have a total of 57 beds, 110 nurses, and 5 intensivists. The sample subjects for this study were of two categories: nurses and physicians in the ICUs that were involved in the post-insertion care and the episodes during which post-insertion care was provided.

During the administration of the self-report questionnaire, the sample included all the nurses and physicians involved in post-insertion care who were present in the ICU. The inclusion criterion was willingness to participate in the study. For care episodes, the inclusion criterion was that the episodes of care were provided to devices at least 24 hours post-insertion and the exclusion criterion was that the devices had been previously observed. The sampling of episodes to observe was conducted using the consecutive sampling technique. The sample size for care episodes was calculated using the World Health Organization's practical guideline (16) and Equation 1.

$$n = \frac{Z^2_{1-\frac{\alpha}{2}} \times \mathrm{P}(1-\mathrm{p})}{d^2} \quad (1)$$

Using d = 0.06, the minimum sample size required for this study was 276 post-insertion care episodes.

3.1.3. Data Collection

Data were collected for a 4-month period from February to May 2014. Data collection was of two types: the observational data and the self-reported data. The observational data formed the first set of data and was collected by the researcher using the checklist. The ICUs operated a three shift system with morning, evening, and night shifts. Observation was mostly completed during the morning shift as most patient care activities are performed during this shift. Direct observation by the researcher was done during the care process. A few items on the checklist were assessed based on the documentations on the patients' chart after the care process such as cuff pressure and the need for device assessments.

After the researcher gathered the observational data, the self-report questionnaires were distributed in person to willing nurses and physicians who were working in the ICU during site visits. Each participant answered all three questionnaires relating to each device. Participants were asked to complete the questionnaires during the site visit and return them directly to the researcher. Willing but busy participants were given another chance during subsequent site visits.

3.1.4. Ethical Considerations

Ethical approval was obtained from the research ethical committee of the Tehran University of Medical Sciences (ethics code: 9123655001-1392/101231). Further approval was obtained from the director, the research deputy, the nursing director, and the heads of all of the ICUs involved in the study. Health personnel of the units were also informed by the heads of the units of the purpose and objectives of the researcher in their unit.

During data collection, anonymity of both the personnel and patients was ensured to prevent any form of economic harm or reward for a staff member due to his practice as well as to maintain each patient's confidentiality. More so, written informed consent was obtained from all health professionals who agreed to answer the questionnaires.

3.1.5. Data Collection Tools

A checklist and a questionnaire were used for data collection. The checklist was developed by the researcher for each device based on a CDC or a SHEA guideline. Items for the CVC checklist were modeled from the recommendations of the CDC guideline for the prevention of intravascular catheter-related infection (9, 17). Items for the IUC checklist were modeled from the recommendations of the CDC guideline for the prevention of catheter-associated urinary tract infection (18, 19). Items for the MV checklist were modeled from the recommendations of the SHEA guideline for the prevention of ventilator-associated pneumonia in acute care (20). The IUC checklist had eight items, the CVC checklist had five items, and the MV checklist had six items. Each item on the checklist had a dual response of either "yes" or "no". "Yes" indicated adherence with the recommendation and "No" indicated non-adherence. The demographic data collected included: the name of the unit and the professional discipline of the care provider.

The self-reported questionnaire was composed of closed-answered questions and 11 items in two sections. Section A, titled "Leadership support measures", was composed of five items that investigated leadership support to enhance adherence to evidence-based recommendations. These questions were modeled after the association for professionals in infection control and epidemiology's (APIC) guideline of infection control risk assessment (21). Responses were dichotomous with either a "yes" or "no" answer for each item. Section B, titled "Compliance with Recommendation", was composed of six items. Separate questionnaires were developed for each device, and each item of these questionnaires was modeled after the CDC or SHEA guidelines as earlier mentioned. They had three response options: implement, sometimes implement, or never implement, and the participant had to choose one option based on their practices. The demographic data collected included: gender, professional discipline, years of ICU experience, and type of ICU.

3.2. Reliability and Validity

CDC and SHEA guidelines were used to model the items of both the checklist and the questionnaires. They were reviewed by three ICU nurse professors and one biostatistician at two different occasions for content validity. Each reviewer was familiar with the guidelines and commented on the adequacy of the match between the guidelines and the questions. Recommendations were made for the addition, deletion, and revision of some items. Furthermore, the questionnaire was distributed to 10 nurses employed in the general ICU to evaluate readability and time to complete. None of these nurses had questions or concerns about the questions and they were able to complete the questionnaires within six minutes.

Internal consistency was verified by calculating the mean inter-item correlation of each data collection tool. The mean inter-item correlations for the checklists were: MV = 0.23, CVC = 0.46, and IUC = 0.43. Likewise, the mean inter-item correlations for Section B of the questionnaires were: MV = 0.20, CVC = 0.35, and IUC = 0.20. The alpha Cronbach coefficient for Section A was 0.86.

3.3. Statistical Analysis

IBM SPSS version 22 was used for statistical analysis. Separate data sets were developed for each device's checklist and questionnaire responses. Descriptive statistics were used to describe the basic features of the data. Leadership support measures were scored on a two-point scale: "1" if "yes" and "0" if "no". The ANOVA test was applied to identify significant differences among the mean scores of the three devices. A P Value of less than 0.05 indicated a significant difference.

4. Results

The self-report questionnaire was answered by 101 of 115 nurses and physicians, giving a response rate of 87.8%. 96 of the respondents were nurses (95.0%), 90 (89.1%) were females and 34 (33.6%) were from the general ICU. The mean of years of ICU experience was 6.7 ± 5.1 years, with a minimum of one year and maximum of 21 years. 43 (42.6%) respondents had an experience of less than five years as seen in Table 1.

Although the minimum sample size for observed care episodes was 276, 332 episodes were observed. Of these, 117 (35.2%) were episodes for CVC post-insertion care, 130 (39.2%) were episodes for IUC post-insertion care, and 85 (25.6%) were episodes for MV post-insertion care. Nurses were the primary care providers (100%) of the post-insertion care. The majority of the episodes observed were from the general ICU as it is the biggest ICU, having 20 beds, in the complex.

Table 1. Frequency Distribution of Demographic Characteristics of the Surveyed Population

Category	No. (%)
Gender	
Male	11 (10.6)
Female	90 (89.4)
Profession	
Physician	5 (5.0)
Nurse	96 (95.0)
Years of ICU experience, y	
≤ 5	43 (42.6)
6 - 10	37 (36.6)
11 - 15	9 (8.6)
≥ 16	9 (8.6)
Unit	
General ICU	34 (33.3)
Open heart ICU	23 (23.4)
Neurology ICU	15 (15.2)
Emergency ICU	14 (13.5)
Cancer surgical ICU	15 (14.5)
Device	
Mechanical ventilator	101 (33.3)
Indwelling urinary catheter	101 (33.3)
Central line catheter	101 (33.3)

4.1. Adherence to Post-Insertion Evidence-Based Recommended Care Procedures for a CVC

The overall observed adherence rate to CVC post-insertion care recommendations was 18.3%, while the self-reported adherence rate was 78 76.6%. Figures 1 and 2 show that of the 59 (58.4%) respondents who reported to always disinfect the CVC hub before accessing it, none (0.0%) were observed in practice to disinfect the CVC hub before accessing. Also, of the 67 (66.3%) who reported to comply with hand hygiene before any manipulation of the CVC, only 10 (8.5%) actually complied with this recommendation during observations. Furthermore, none of the units used a greater than 0.5% concentration Chlorhexidine antiseptic for the CVC site dressing as recommended and there was no documentation of daily assessments of the need for CVC for each patient.

4.2. Adherence to Post-Insertion Evidence-Based Recommended Care Procedures for an IUC

The overall adherence rate to IUC post-insertion evidence-based care recommendations according to the self-report questionnaire was 80.4% and according to the observation checklist was 59.1%. Figures 3 and 4 show that of the 101 (100%) respondents who reported to always secure the IUC after insertion, the IUC was only secured in 64 (19.3%) of the observed IUC episodes. In addition, there was no documentation of a daily review of the need for an IUC for each patient. Non-adherence to the recommendation of using clean containers in emptying the collecting bag was found to be up to 73.8%, while 63.8% did not adhere to the use of an aseptic technique during the manipulation of the catheter collecting system.

4.3. Adherence to Post-Insertion Evidence-Based Recommended Care Procedures for an MV

total adherence rate to the MV post-insertion evidenced-based care recommendations according to the SHEA guideline was 59.6% and 43.1% for the self-reported questionnaire and the observation checklist, respectively. Figures 5 and 6 show there was an absence of documentation for cuff pressure, bed inclination, and of a weaning protocol, though 86 (85.1%) respondents reported they used a weaning protocol for weaning and 76 (75.2%) reported they maintained all patients in a semi-recumbent position. Furthermore, though 67 (66.3%) respondents reported they performed regular antiseptic oral care for all MV patients, only in 4 (9.4%) of the observed episodes was antiseptic oral care performed.

4.4. Leadership Support of Measures to Promote Adherence to Evidence-Based Practices

According to the self-report responses shown in Figure 7, 36 (35.6%) respondents reported a lack of practice guidelines and 53 (52.5%) respondents reported that they had not received training on HAI preventive measures. Furthermore, 70 (69.3%) respondents reported a lack of routine surveillance of adherence to recommended practices and another 83.5% reported a lack of sufficient nursing staff in the units. In addition, 62 (61.4%) respondents ranked the leadership support to ensure adherence with evidence-based practices as weak. The mean ± SD score for the leadership support measures was 2.07 ± 1.50 (range: 0 - 5). However, the reported received leadership support to ensure adherence to evidence-based practices was statistically different for the three procedures of CVC, IUC, and MV (P = 0.042, ANOVA test).

5. Discussion

To our knowledge, this is the first report describing the adherence rates to evidence-based post-insertion recommended care procedures for CVCs, IUCs, and MVs in Iranian

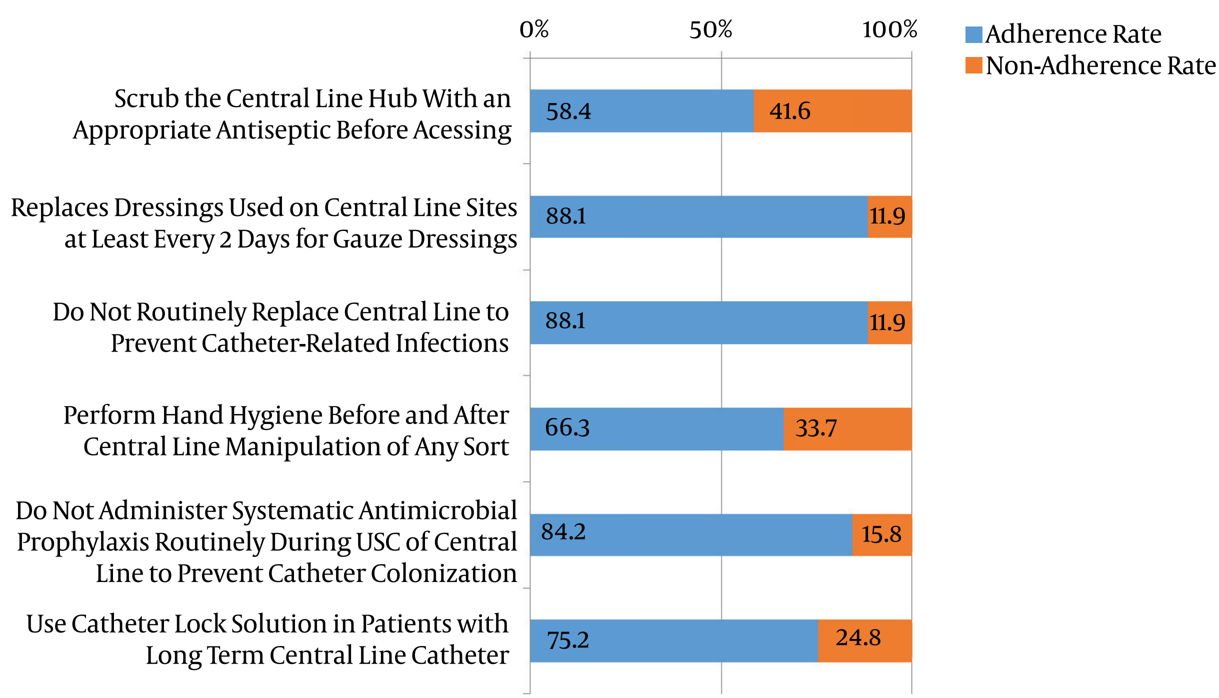

Figure 1. Self-Reported Adherence Rates to CVC Post-Insertion Care Recommendations

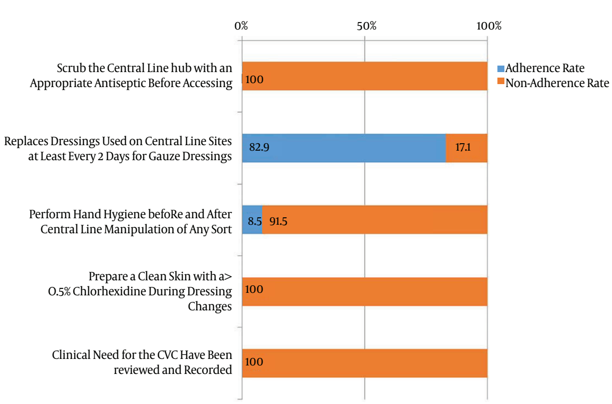

Figure 2. Observed Adherence Rates to CVC Post-Insertion Care Recommendations

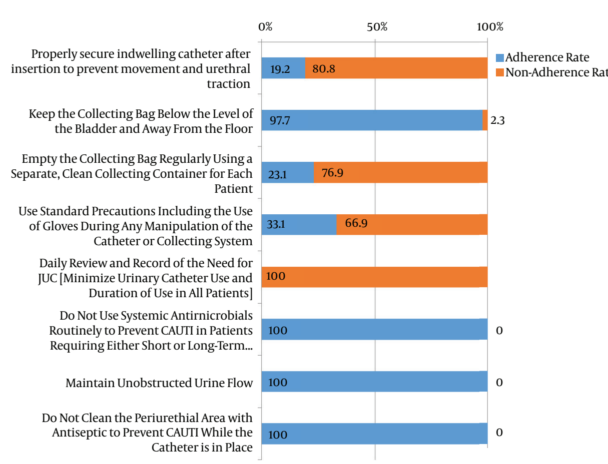

Figure 3. Self-Reported Adherence Rates to IUC Post-Insertion Care Recommendations

ICUs. Though adherence to evidence-based practices has been reported to be the cornerstone for HAI rate reduction, this study demonstrated a low adherence to the evidence-based post-insertion recommendations of the CDC and SHEA guidelines compared with other studies. This study recorded an initial actual adherence rate of 18.3% to CVC evidence-based recommendations as opposed to the 62.0% recorded by Berenholtz et al. in the John Hopkins hospital ICU (22) and the 68.5% recorded by Ider et al. in ICUs of tertiary hospitals of Mongolia (23). Likewise, the overall adherence reported for MV was 59.6% as opposed to the 77.7% reported in the study by Ricart et al. on ICU nurses presented at an international conference in Europe (24).

Furthermore, inconsistencies were recorded between self-reported adherence rates and observed adherence rates across all three devices. For example, of the 101 (100%)

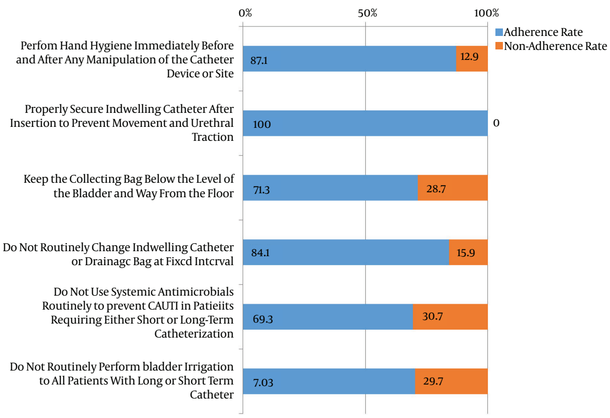

Figure 4. Observed Adherence Rates to IUC Post-Insertion Care Recommendations

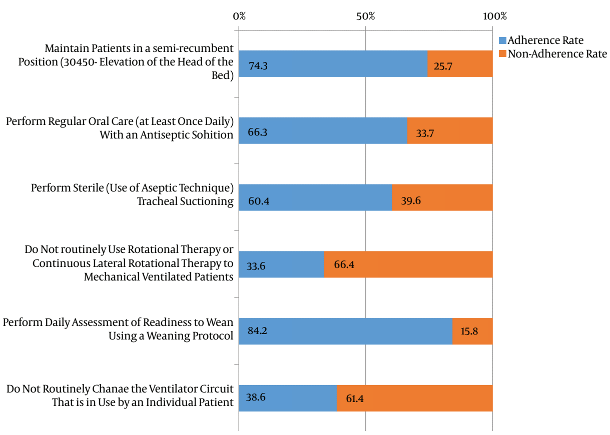

Figure 5. Self-Reported Adherence Rates to MV Post-Insertion Care Recommendations

who reported to properly secure the IUC after insertion, only 64 (19.3%) episodes actually adhered to this recommendation in practice. This finding is supported in the study by Grap and Munro in which 90% of the nurses surveyed reported to be adherent with hand washing, but only 22% proved to actually be adherent when observed (25). This apparently illogical finding stems from the large gap that exists between what we know and the way we practice.

Also, in this current study, in none of the observed episodes was the CVC hub disinfected before being accessed. In one study where 31% of nurses did not disinfect the CVC hubs before accessing them, 17% of blood samples drawn through these CVCs had microbial growth (26). Blood stream infections (BSIs) arising from an intraluminal source reflects a breach in the aseptic technique such as during the manipulation of the catheter hubs, caps, or

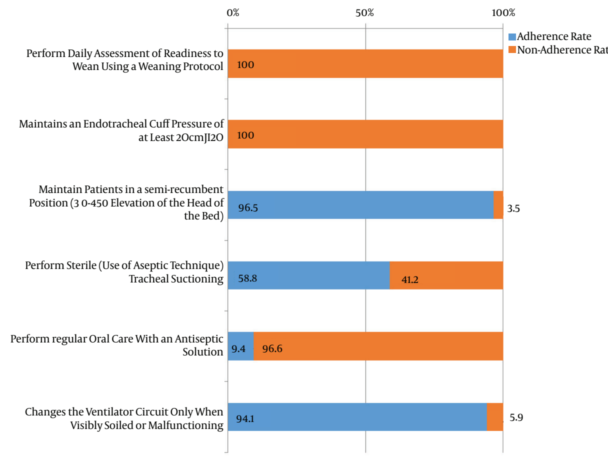

Figure 6. Observed Adherence Rates to MV Post-Insertion Care Recommendations

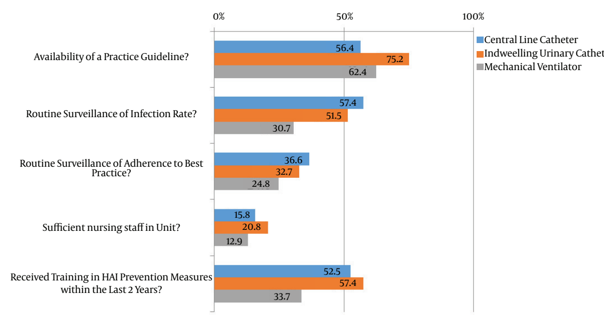

Figure 7. Leadership Support Measures to Enhance Adherence to Evidence-Based Practices

stopcocks (27). When microbes gain access to the intraluminal or extraluminal surface of the CVC, they become irreversibly bonded and begin to produce a biofilm that incorporates the microbes and provides a protective environment against the host's defenses as well as antibiotics (28).

More so, the use of a 10% povidone-iodine solution for CVC site dressing was the routine practice in the units despite the fact that a > 0.5% Chlorhexidine solution is recommended by the CDC practice guideline. According to the evidence presented in the CDC guideline, in a three-armed study (2% aqueous chlorhexidine gluconate versus 10% povidone-iodine versus 70% alcohol), 2% aqueous chlorhexidine gluconate tended to decrease catheter-related BSI compared to 10% povidone-iodine or 70% alcohol. In addition, a meta-analysis of 4,143 catheters suggested that a chlorhexidine preparation reduced the risk of catheter-related infection by 49% (95% CI .28 to .88) relative to povidone-iodine (9). Thus, Chlorhexidine preparations were associated with lower rates of catheter colonization at the insertion site compared with povidone-iodine or alcohol.

Also, in the critical care setting, poor oral hygiene has been associated with increased dental plaque accumulation, bacterial colonization of the oropharynx and higher VAP rates (20). However, in this current study, there was only a 9.4% adherence to oral hygiene for MV patients. In their study on oral care in the ICU, Johnstone et al. reported that some nurses perceive oral hygiene care to be of low priority and they lack the necessary knowledge of oral health assessment and hygiene practices (29). However, according to Cason et al. (30), hospitals with an oral care protocol are more likely to regularly provide oral care. Thus, we can confidently argue here that these ICUs' lack of an oral care protocol and lack of knowledge are accountable for the low adherence to oral care recommendations shown in Figure 7.

In regard to the leadership role in enhancing adherence to evidence-based practices, a joint statement on HAI elimination by the CDC, SHEA, and the APIC emphasized leadership support at the highest levels of the facility and leadership and guidance from healthcare epidemiologists and experts in infection prevention and control (31). Leadership should include the education and training of personnel, provision of practice guidelines, and surveillance of infection rates and compliance rates (9). In the current study, our findings demonstrate statistically significant weak leadership support in ensuring adherence with evidence-based practices ($P = 0.04$). However, according to Quiros et al. (32), various demographic variables within an ICU such as the professional category, the gender, and the number of ICU beds could affect their adherence to recommended practices. For example, in their study, they reported that nurses were adherent than physicians, older personnel were more adherent than younger personnel, and females were more adherent than males.

5.1. Conclusion

In conclusion, our study demonstrates that adherence to evidence-based post-insertion recommended care procedures to prevent device-acquired HAI is not consistently and uniformly implemented in these ICUs and leadership support measures to ensure adherence is weak. Though no study has reported initial adherence rates of 100% to CDC practice guidelines, interventional studies demonstrated a reduction in infection rates as adherence approaches 100%.

For example, at the John Hopkins surgical ICU, the interventions of Berenholtz et al. increased the adherence rate to central line evidence-based practices from 62% to 85% and the consequence was the complete elimination of CVC-BSI in their ICU after 4 years of intervention (22). In a related study based in the ICUs of nine hospitals in the USA, after interventions for six months, adherence to MV guidelines increased from 50% in the first three months to 83% in the final three months resulting in the mean VAP rate deceasing by 41% over the same time frame (33).

Our findings will encourage Iranian ICU practitioners and leaders to critically review their infection management policies with the aim of reinforcing compliance to evidence-based practices and not only infection surveillance. Nonetheless, we recommend further studies with interventions to improve adherence rates as well as studies that include a larger scope of evidence-based recommendations.

5.2. Limitations of the Study

The use of an external guideline, the content of which the practitioners may not be aware of, was opinionated. However, some of the investigated recommendations are conventional based on their level of evidence.

Not all of the post-insertion care recommendations of these guidelines were investigated. Thus the conclusion is somewhat biased as it does not present the overall adherence rate based on the number of recommendations available on the guideline. Also, the Hawthorne effect was another anticipated limitation of the study. To minimize this effect, the specific aspects on the checklist that would be observed were not disclosed to the practitioners.

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Footnotes

Conflict of Interest: No conflict of interest to declare.

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