Quality Improvement

# Hand Hygiene and Hospital-Acquired Infections During COVID-19 Increased Vigilance: One Hospital's Experience

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## Abstract

### Background
Hospital-acquired infections are associated with increased morbidity, mortality, costs and length of stay. Prior studies have linked increased hand hygiene compliance with reduced hospital-acquired infection rate. With the increased vigilance for personal and institutional hygiene practices during the COVID-19 pandemic, we hypothesized increased hand hygiene compliance and, as a result, decrease in hospital-acquired infections in our hospital.

### Methods
Hand hygiene compliance data was provided by the hospital's Quality Department. We queried and empirically analyzed local hospital-acquired infection data obtained from our Quality Department and the National Healthcare Safety Network. We compared local hand hygiene compliance rates before and after the implementation of increased infection prevention and control measures in March 2020 and correlated various hospital-acquired infection rates with hand hygiene compliance.

### Results
Our results showed a statistically significant and sustained increase in compliance with hand hygiene at our hospital after implementation of hospital-wide infection control measures. We demonstrated a downward trend in all hospital-acquired infections, which was not statistically significant. A strong statistically significant negative correlation was found between hand hygiene compliance and the rate of *Clostridium difficile* hospital-acquired infection.

### Conclusion
Hand hygiene adherence has increased since the beginning of COVID-19 pandemic in our hospital, and a noticeable, although not statistically significant, downward trend in most of the analyzed hospital-acquired infections was identified. A significant limitation to our study was small sample size. Future studies are warranted to further analyze the impact of increased hygiene practice on the incidence of hospital-acquired infections.

### Keywords
COVID-19; SARS-CoV-2; coronavirus infections/complications; coronavirus infections/pathology; coinfection/epidemiology; bacterial infections/epidemiology; cross infection/prevention & control; guideline adherence; hand disinfection; infection control/methods; hospital-acquired infection; nosocomial infection

## Introduction
Hospital-acquired infections (HAI) are infections considered not to be present or incubating prior to admission to the hospital.[1] Annually, approximately 1.7 million hospitalized patients are diagnosed with HAIs while being treated for other health issues, and more than 98,000 of these patients die due to HAI.[2] Approximately 1 in every 25 inpatients in U.S. acute care hospitals suffers from at least one HAI.[3] The

most common HAIs are pneumonia, surgical site infections and gastrointestinal infections.[3] The leading organisms in the U.S. responsible for HAI include *Clostridium difficile* (*C. diff*) (12.1% of HAIs), followed by methicillin-resistant *Staphyloccocus aureus* (MRSA) (10.7%), *Klebsiella pneumoniae/oxytoca* (9.9%), and *Escherichia coli* (9.3%).[3]

Prior studies have linked hand hygiene compliance (HHC) by health care providers to hospital-acquired infections.[4] As such, hand hygiene has been part of the Joint Commission National Patient Safety Goals, as well as local and regional goals for hospitals and corporations. As simple as it may be, hand hygiene is an ongoing challenge worldwide with suboptimal compliance in spite of multiple initiatives to increase adherence.[5]

Since the nationwide outbreak of the Coronavirus disease 2019 (COVID-19), the Centers for Disease Control and Prevention (CDC) developed guidelines to prevent community and in-hospital spread of Severe Acute Respiratory Syndrome-associated Coronavirus 2 (SARS-CoV-2).[5] Our hospital, Osceola Regional Medical Center in Kissimmee, FL, rapidly implemented comprehensive practices for enhanced institutional and personal hygiene in March 2020. Our policy focused on hand hygiene, universal face coverings, expanded environmental services and restriction of non-essential personnel and visitors.

With the addition of intensified infection prevention and control (IPC) measures throughout the course of the COVID-19 pandemic, we hypothesized that (i) the hand hygiene compliance at our hospital will have significantly increased and, as a result, (ii) the incidence of non-COVID-19-related hospital-acquired infections will have decreased.

## Methods

We performed a cross-sectional retrospective observational study to examine the effect of COVID-19-related infection prevention control measures on hand hygiene compliance and hospital-acquired infections at Osceola Regional Medical Center in Kissimmee, FL, from January 2019 through June 2020.

Hand hygiene performance is routinely acquired and documented in all areas of our hospital via direct observation by a concealed recorder using a standardized form. The observer records whether hand hygiene is performed, by whom, and the potential contributing factors for non-performance. Hand sanitizer use and hand washing with soap and water are logged indistinctly. The data are stored at the local Quality Department. The HAI data were obtained by querying the local Quality Department and the National Healthcare Safety Network (NHSN) database. The standardized infection ratio (SIR) compares the observed versus the expected number of infections in a particular population. The expected number is calculated based on several variables, including case mix and number of hospitalized patients. A higher SIR (ratio > 1) indicates a higher than expected number of infections, suggesting the need for more prevention control measures. A lower SIR (ratio < 1) indicates a lower than expected number of infections.

We queried HAI data for: catheter-associated urinary tract infections (CAUTI), central line-associated blood stream infections (CLABSI), *C. diff* and MRSA infections, from January 2019 through June 2020. For CAUTI and CLABSI the SIR is reported monthly, while for *C. diff* and MRSA the SIR is reported quarterly.

We used IBM SPSS Statistics 24 for statistical analysis.[6] We performed separate two-way t-test analyses to compare the pre- and post-implementation of enhanced infection prevention measures, mean HHC and mean SIR of CAUTI, CLABSI, *C. diff* and MRSA. We then performed a Pearson correlation analysis between hand hygiene compliance and the SIR of CAUTI, CLABSI, *C. diff* and MRSA. For CAUTI and CLABSI the SIR is reported monthly, thus the timeframe for pre-implementation included January 2019 through February 2020, and post-implementation was March through June 2020. For *C. diff* and MRSA the SIR is reported quarterly, thus the timeframe for pre-implementation included quarters 1–4 of 2019, and post-implementation included quarters 1 and 2 of 2020. Thus, March 2020, which is part of quarter 1, was included in the post-implementation data.

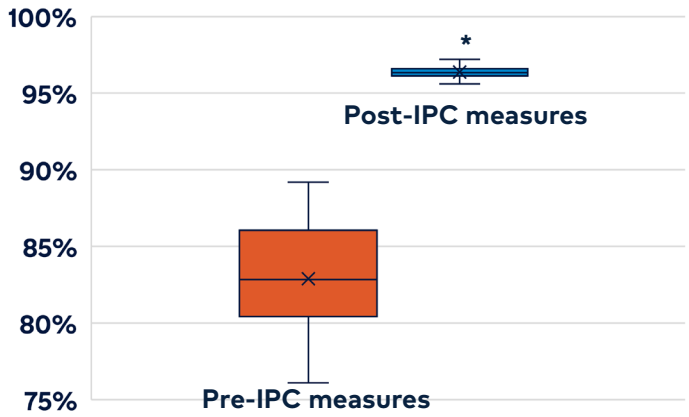


**Figure 1.** A boxplot comparing hand hygiene compliance percentage pre- (January 2019 to February 2020) and post- (March to June 2020) implementation of infection prevention control measures at Osceola Regional Medical Center, showing a significant increase in compliance. IPC=infection prevention control; * p < 0.001.

# Results

## Summary of results

HHC is shown in a boxplot diagram (**Figure 1**) and linear graph (**Figure 2**). SIRs for the various HAIs are shown in **Figure 2**.

HHC at Osceola Regional Medical Center has significantly and sustainably increased from 82.9 ± 4.1% (mean ± SD, n=14) before the COVID-19 pandemic (January 2019 to February 2020) to 96.4 ± 0.7% (mean ± SD, n=4) during the COVID-19 pandemic (March to June 2020) (p<0.001, t-test). Correlation analysis of HHC and HAIs showed a strong negative correlation only for hospital-acquired *C. diff* infection (r=-0.828, n=6, p<0.05).

## *C. diff*

SIR for *C. diff* decreased from 0.48 ± 0.12 (mean ± SD, n=4, quarters 1–4 of 2019) to 0.26 ± -0.25 (mean ± SD, n=2, quarters 1–2 of 2020) (p=0.20, t-test) and had a statistically significant strong negative correlation with HHC (r=-0.828, n=6, p<0.05).

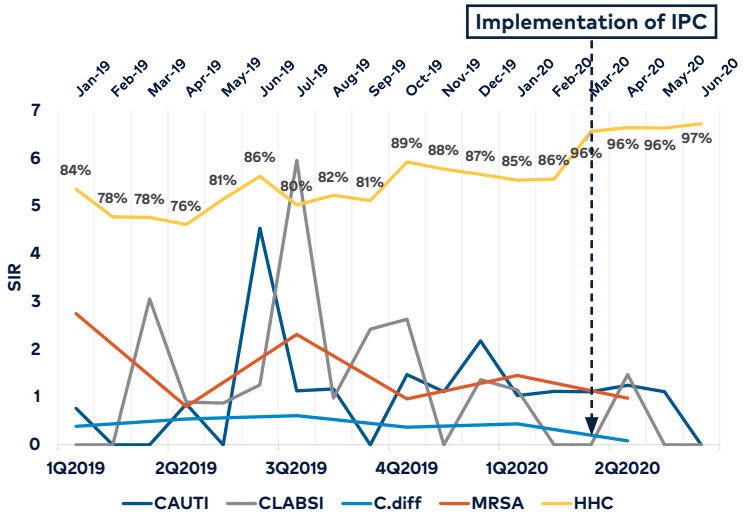


**Figure 2.** A chart showing an increase in hand hygiene compliance and a decrease in the standardized infection ratio for hospital-acquired infections after implementation of infection prevention control measures at Osceola Regional Medical Center between January 2019 and June 2020. A decrease in the standardized infection ratio indicates a lower-than-expected number of infections. IPC=infection prevention control; Q=quarter; SIR=standardized infection ratio; CAUTI=catheter-associated urinary tract infection; CLABSI=central line-associated blood stream infection; *C.diff=Clostridium difficile*; MRSA=methicillin-resistant *Staphylococcus aureus*.

### CAUTI

SIR for CAUTI decreased from 1.10 ± 1.18 (mean ± SD, n=14, January 2019 to February 2020) to 0.87 ± 0.58 (mean ± SD, n=4, March to June 2020) (p=0.72, t-test) and had a weak positive correlation with HHC (r=0.191, n=18, p=0.447).

### CLABSI

SIR for CLABSI decreased from 1.47 ± 1.63 (mean ± SD, n=14, January 2019 to February 2020) to 0.37 ± 0.73 (mean ± SD, n=4, March to June 2020) (p=0.21, t-test) and had a moderate negative correlation with HHC (r=-0.351, n=18, p=0.153).

### MRSA

SIR for MRSA decreased from 1.70 ± 0.97 (mean ± SD, n=4, quartiles 1–4 of 2019) to 1.21 ± 0.34 (mean ± SD, n=2, quartiles 1–2 of 2020) (p=0.55, t-test) and had a moderate negative correlation with HHC (r=-0.580, n=6, p=0.228).

## Discussion

The number of COVID-19 cases has placed an enormous stress on healthcare systems worldwide.[7] The lack of highly effective treatments, severity and mortality of COVID-19 disease has emphasized the importance of community and hospital-based IPC measures to prevent transmission of SARS-CoV-2. Strict visitation, universal use of personal protective equipment (PPE) and hand hygiene policies have been implemented since March 2020 in hospitals across the country.[5] These institution-wide infection control measures have been described as effective and associated with fewer in-hospital transmissions of SARS-CoV-2.[8] HHC by health care providers is a constant challenge for hospitals all over the world.[9,10] While not ill-intended, hand hygiene is a frequent error of omission. HAI rates negatively correlate with hand hygiene performance rates and are potentially preventable by increasing HHC. This can have a great impact on our healthcare system as HAIs are associated with significant financial and patient harm.[4]

We hypothesized that increased vigilance during the COVID-19 pandemic would be associated with an increase in HHC and a resulting decrease in non-COVID-19 HAIs.

Our results showed a statistically significant increase in HHC by health care providers in our hospital since March 2020 to a consistent compliance rate over 95%. This increase shows that with a strong enough stimulus, particularly such that supports personal safety, providers are likely to focus their attention on the required protocol. This is consistent with psychological theories that personal investment is a stronger driver for action than simply following a protocol.[11] We hope that this change in behavior will persist beyond the pandemic and become a habitual practice that is deeply ingrained as a pattern for every health care provider. It is, however, important to note that even with the pandemic threat, HHC has not reached 100% as of yet. It is possible that the use of PPE may be providing a sense of protection that lowers the vigilance of providers for hand hygiene. Also, these results are from a single center, and no external data regarding HHC were available for comparison.

SIRs for HAIs at our hospital showed a general downward trend in these infections since the beginning of the COVID-19 pandemic. A strong negative correlation was found between SIR for *C. diff* and HHC (r=-0.828, n=6, p<0.05). *C. diff* spores on surfaces can remain infectious for weeks to months and their microbicidal resistance to alcohol-based sanitizers is known.[12] Only bleach-based products or soap and water hand hygiene have been demonstrated to be effective at preventing *C. diff* transmission.[12] During the COVID-19 pandemic, environmental services have sterilized rooms using bleach and UV light. We postulate that since other reported HAIs are susceptible to alcohol-based products and do not form spores, the most benefit, and therefore statistically significant correlation between HHC and infection rate has been observed only for *C. diff*. Our study is limited to a single center and the lack of statistical significance in our results is likely due to our small sample size. Studies including HHC and HAI data on a larger scale should be pursued to further investigate our hypothesis. Notwithstanding, even though a significant difference was not observed for HAIs, a clinically and financially significant difference could still be present. The enormous need for PPE overwhelmed supply chains worldwide.[13] This imparted great stress on hospital administrations to provide a safe working environment per Occupational

Safety and Health Agency (OSHA) regulations. Since higher costs are strongly associated with HAIs, the potential savings generated from preventing these infections could be directed towards the sustainability of PPE supply. Analysis of HAI-related morbidity, mortality, length of stay and costs comparing before and after the COVID-19 pandemic would be useful to investigate this hypothesis.

The observed raw number of HAIs in our hospital has notably decreased since the outbreak of COVID-19. Similarly, a paradoxical nationwide decreased number of hospital admissions, even for life-threatening conditions, was noted since the emergence of SARS-CoV-2.[14] We postulated that analyzing the absolute number of HAIs without taking into account the number of hospitalizations would erroneously suggest a decrease in HAIs. Therefore, we only performed a statistical analysis using the SIR, which takes into account and corrects for the actual number of hospitalized patients at risk for HAIs, regardless of COVID-19 status or case mix index during the study period.

Viral and bacterial co-infections in patients with COVID-19 have been reported.[16,17] The use of immunosuppressants, such as corticosteroids, hydroxychloroquine and IL-6 monoclonal antibodies, particularly in patients with severe COVID-19 pneumonia, increases their susceptibility to HAIs. However, the incidence of HAIs in this population has not been reported to our knowledge. It is plausible that attempts to preserve PPE or decreased vigilance to infection prevention other than COVID-19 has led to unintentional decreased compliance with infection prevention protocols. Notwithstanding, the lack of an observed significant increase in HAIs despite increased patient susceptibility to co-infection suggest widespread infection prevention measures may have prevented an increase in HAIs, which further supports our hypothesis.

Although prior studies have shown that increased HHC decreases HAIs, we only observed this trend for *C. diff*. We did not observe a universal statistically significant strong negative correlation between HHC and all types of HAIs. Moreover, the association seemed different (non-statistically significant) both in strength and direction when analyzing pre- and post-COVID-19 pandemic data. We did not anticipate that the strength, and particularly the direction of association, between HAIs and HHC would differ with higher HHC, and in the absence of statistical significance it most likely does not. Limitations to our findings are possibly explained by the already remarkably high pre-COVID-19 reported HHC rate (mean 82.9%) at our hospital prior to the implementation of increased infection prevention measures, compared to the overall national mean of 40%.[15] The magnitude of the effect of a further increase in HHC is therefore harder to capture, particularly in the setting of a small sample size. Another aspect of the small sample size limitation is that we applied the Pearson correlation analysis on a small number of observations, especially for *C. diff* and MRSA, which may have given rise to less meaningful results. Lastly, using quarterly data blurs the distinction between pre- and post-COVID-19 data, since the time of implementation of enhanced infection prevention measures falls in the midst of quarter 1 of 2020, thus rendering the data point of quarter 1 less accurate. Nonetheless, we decided to include quarter 1 data with the post-COVID-19 data to allow for 2 data points for analysis (quarters 1 and 2 of 2020).

## Conclusion

After implementation of universal IPC policies during the COVID-19 pandemic, we have observed enhanced HHC, which was statistically significant, and a decreased trend in HAIs at our hospital. A statistically significant negative correlation was found between HHC and the rate of hospital-acquired *C. diff* infections.

Overall, we believe that health care workers' fear and increased awareness of nosocomial transmission of disease have positively influenced behavior resulting in enhanced personal and institutional cleanliness. We hope that our results increase the awareness of the known and potential benefit of universal infection prevention control interventions on HAIs and serve as a stimulus for hospitals to continue investing in PPE. We recommend continued monitoring of HAIs during the COVID-19 pandemic to aid in the development of further and cost-effective infection prevention and control strategies.

## Conflicts of Interest

The authors declare they have no conflicts of interest.

The authors practice at Osceola Regional Medical Center, a hospital affiliated with the journal's publisher.

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