

## Research Article

# Influence of COVID-19 Pandemic on Health-care Workers' Hand Hygiene Practice at a Private Academic Hospital in Johannesburg, South Africa: A Quantitative and Qualitative Longitudinal Study

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## ABSTRACT

**Background:** Hand hygiene (HH) is a cornerstone infection prevention measure and is crucial in the fight against the COVID-19 pandemic. Improving and monitoring of HH compliance in a hospital setting is a complex challenge given the behavioural component associated with it. We aimed to assess the impact of the COVID-19 pandemic on HH compliance using both quantifiable hand product usage and observational data.

**Methods:** Using the hospital's HH usage monitoring system, the quantity of different HH products per nursing unit, expressed as millilitres (mL) per patient bed day (PBD), was analysed longitudinally during the course of the pandemic. Observational HH compliance data was drawn from the hospital audit system for comparison.

**Results:** Across all units, there was a significant increase in HH product usage coinciding with the onset of the pandemic (53 mL/PBD to 111 mL/PBD, in non-critical care units (non-CCU's); 127 mL/PBD to 217 mL/PBD, in CCU's). This increase was largely attributable to an increase in alcohol-based hand rub usage. Discordance with observed compliance rates was noted.

**Conclusion:** An unprecedented increase in HH product usage in a hospital setting was seen to coincide with the onset of the COVID-19 pandemic. No specific HH campaign was introduced, and the improved usage compliance appears to be driven primarily by health-care workers' own behavioural change.

**Keywords:** Hand hygiene practice, Alcohol-based hand rub, COVID-19 pandemic, Behavioural change, Quantitative and qualitative quality improvement

## INTRODUCTION

Hand hygiene (HH) is considered a cornerstone infection prevention and control (IPC) measure and is universally promoted and adopted. In the context of the COVID-19 pandemic the importance of HH in controlling a virus that is transmitted via respiratory droplets has been emphasised at a societal level, with a consequent ubiquitous

implementation of obligatory hand sanitation in public spaces. South Africa has seen a widespread use of hand sanitiser through regulatory requirements and the heightened awareness of disease prevention that the pandemic has created.(1)

In the hospital setting the importance of HH is well recognised but poorly implemented as evidenced by a

systematic review that demonstrated mean HH compliance rates of 34%, only increasing by 23% following intervention.(2) The reasons for this are multifaceted, ranging from potentially unrealistic compliance goals to the necessity of a behavioural change that is required to produce a sustained improvement.

HH compliance is generally measured subjectively through direct observation, comparing opportunities to events.(3) There are also objective measures where an actual volume of hand product usage can be measured and then adjusted for patient days.(4) This provides a reliable measure of actual HH product consumption and can be extrapolated to compliance.

At the Wits Donald Gordon Medical Centre, a 210-bed quaternary referral hospital, HH is advocated in accordance with the WHO 5 moments of HH,(3) which briefly includes the following: before touching a patient, before an aseptic procedure, after blood and body fluid exposure risk, after patient contact, after contact with a patient's surroundings. HH is monitored through a combination of compliance (direct observation) and product usage (objective quantitative measure) data. The product usage system was implemented from October 2018 to assist in the interpretation of the compliance data, and data presentation has been refined over time, now providing robust and reliable information. Non-critical care units (non-CCUs) include a paediatric, hepatorenal, general, medical, adult oncology and adult oncology high-care unit), and surgical and paediatric transplant unit. CCU units include a surgical and medical CCU sharing one stock room and a state-of-the-art transplant combined adult and paediatric CCU.

The aim of this study is to present the hospital's HH data in the context of the COVID-19 pandemic, demonstrating the impact of the pandemic itself on in-hospital health-care workers' (HCWs) HH compliance and product usage.

## METHODS

### HH products

HH products form part of the hospital's consumable hospital stock and include three commercially available products: (i) an alcohol-only hand rub (AHR) containing 75.15% (w/v) isopropylol and emollients and inert ingredients (PrimeSafe Primary Infection Control 800 mL sachet alcohol hand rub hand sanitiser for installation in a wall-mounted dispenser, Steritech, Pinelands, South Africa); (ii) a chlorhexidine-alcohol combination hand rub containing 70% (w/v) propyl alcohol with 0.5% chlorhexidine gluconate (CHG) and emollients (D-Germ 500 mL pump bottle, B Braun, Johannesburg, South Africa); (iii) an antiseptic scrub containing 4% (w/v) CHG (Bioscrub 500 mL pump bottle, B Braun, Johannesburg, South Africa). From middle November 2020 to end of December 2020, D-Germ 500 mL pump bottles became unavailable and an alcohol-only hand disinfectant containing 70% alcohol (96% ethanol blend), leaf extract of *Aloe Vera Barbadenis* and emollients and

inert ingredients (Adco Hand Disinfectant 500 mL pump bottle, Adcock Ingram, Johannesburg, South Africa) was supplied to the hospital. All products are used according to their specific indications of use. Products are strategically placed at entrances to cubicles and at each bedside. The product is available to all staff working in the hospital, including ancillary staff and visitors.

### HH usage monitoring system

All consumable products, including HH products, are ordered from the hospital pharmacy store by each nursing unit's administrative assistant (UAA) using a standardised monthly consumable order form. There is a predetermined stock level (monitored and adjusted according to use) for each nursing unit for each HH product. When placing an electronic order, the UAA assesses on-hand quantities to determine required order quantities to maintain stock levels. A printed copy of the electronic order form is sent to the pharmacy store. Issued quantities are manually recorded by the pharmacy store clerks and once the order is completed, the order is processed on the dispensing system and the electronic form is updated to reflect issued quantities. Non-CCU's order on a weekly basis and CCU's, twice a week. HH product usage for each week is calculated by calculating the difference between the new on-hand quantity (e.g. on the ordering day of week 2) and the previous week's (e.g. week 1) final on-hand quantity (initial on-hand quantity plus issued quantity). The total HH product usage for each product is calculated in mL. Patient bed day (PBD) per unit are routinely recorded. Using this data, the total HH product usage in mL for the month is calculated for each nursing unit, with the total product volume divided by the number of PBD to give the mL/PBD usage.

Unit-specific observational HH compliance rates are audited monthly using the WHO methodology.(3) Briefly, this entails daily covert audits by senior nursing staff of the unit, with the number of opportunities audited proportional to the number of beds in the unit. In addition the IPC manager randomly performs five covert audits per week.

### HH usage analysis

In the absence of local quantitative HH product consumption data to use as a benchmark, we based our analysis and goals on the results of a large, multicentre collaborative study evaluating soap and sanitiser HH product use as a means to assess compliance rates at US health-care facilities.(4) The derived usage data (expressed as mL/PBD) was divided by 1.7 mL (the average volume of a single-dose product from a product dispenser according to industry standard). This result represented the number of times that HH use occurred per PBD. These results were then plotted on a run chart against the international compliance goal. Compliance goals for critical care and non-critical units were 144 and 72 times of total HH usage per PBD,

respectively.(4) The median was plotted and standard run-chart quality improvement methodology was followed to monitor the trends in HH product usage.(5) The observational HH compliance rate (%) was plotted on the secondary axis of the run chart. Finally, a data integrity compliance rate was also plotted on the secondary axis of the run chart. This measured the compliance of individual units with an ordering system of HH products. Run charts with individual HH products in a number of times of HH product use in mL/PBD or sanitiser vs. soap use in mL/PBD were also used to determine which individual HH product contributed to any change.

From March 2020 with the anticipated onset of the COVID-19 pandemic, the hospital began preparedness planning. From a HH perspective, a few changes were implemented. Access to the hospital was restricted and upon entering the hospital hand sanitisation was mandatory. Supplementary HH products were provided for screening at hospital entrances and for use at hospital administrative, management and outpatient units. These orders were processed under a different consumable stock-sale code than normal consumable unit orders. This study does not report on the usage of HH products outside of nursing units. During the preparedness phase, more wall-mounted AHR and CHG-AHR dispensers were installed in the hospital. Emphasis and constant reinforcement of the importance of HH was communicated, but no formal campaign or compliance improvement project was implemented.

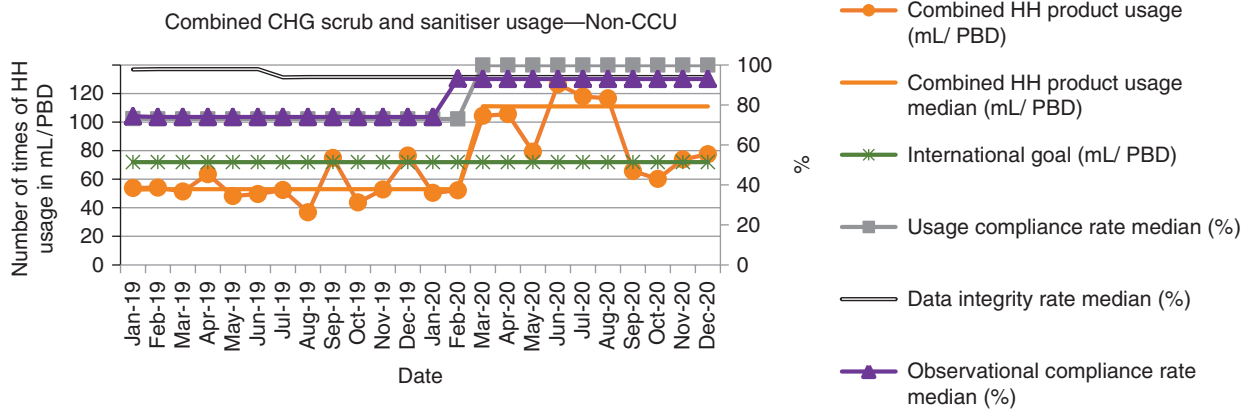
**RESULTS**

**Non-CCU HH product usage**

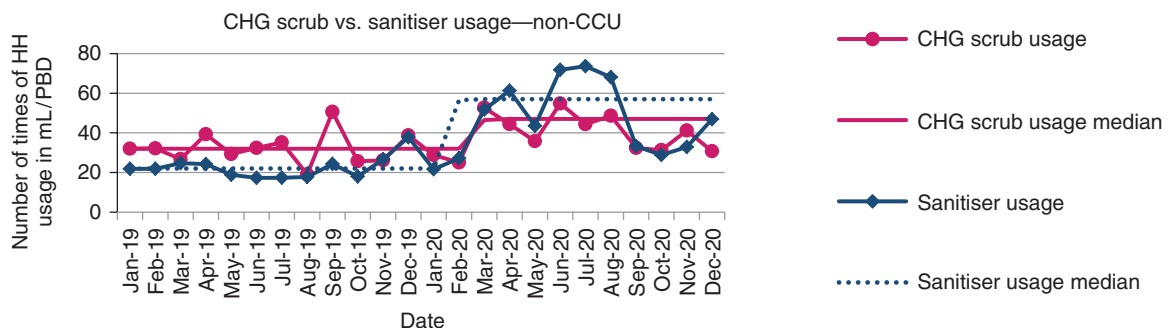
Figure 1 reflects the average combined CHG scrub and sanitiser product use in all seven non-CCUs at the study hospital from January 2019 to December 2020. There was a significant increase in combined CHG scrub and sanitiser usage from 53 times of HH usage in mL/PBD from January 2019 to February 2020 to 111 times of HH usage in mL/PBD from March 2020 to December 2020 (110% increase). A run of four data points well below the median was seen from September 2020. Median usage compliance to the international non-CCU goal (72 times of HH usage in mL/PBD) increased from 74% to 100%, far exceeding the international goal for non-CCU. The median observational compliance rate increased from 74% (January 2019 to January 2020) to 93% from February 2020 onwards. The median data integrity remained at 94% from July 2019.

The increase in HH usage was attributable to a significant median increase in CHG Scrub (45% increase from March 2020), CHG-AHR (144% increase from February 2020) as well as AHR usage (98% increase from March 2020). All three HH products contributed to the combined HH product run below the median from September 2020 to December 2020.

Figure 2 shows that the average non-CCU increase in sanitiser usage exceeded the increase in CHG scrub usage with a median increase of 157% from February 2020 vs.



**Fig 1:** Combined CHG scrub and sanitiser product usage – non-CCU



**Fig 2:** CHG scrub vs. sanitiser usage – non-CCU

45% from March 2020, respectively. From September 2020, sanitiser data points showed an initial run below the median increasing towards the median again in November 2020 and December 2020. CHG scrub data points from September 2020 to December 2020 showed a run below the median.

**CCU HH product usage**

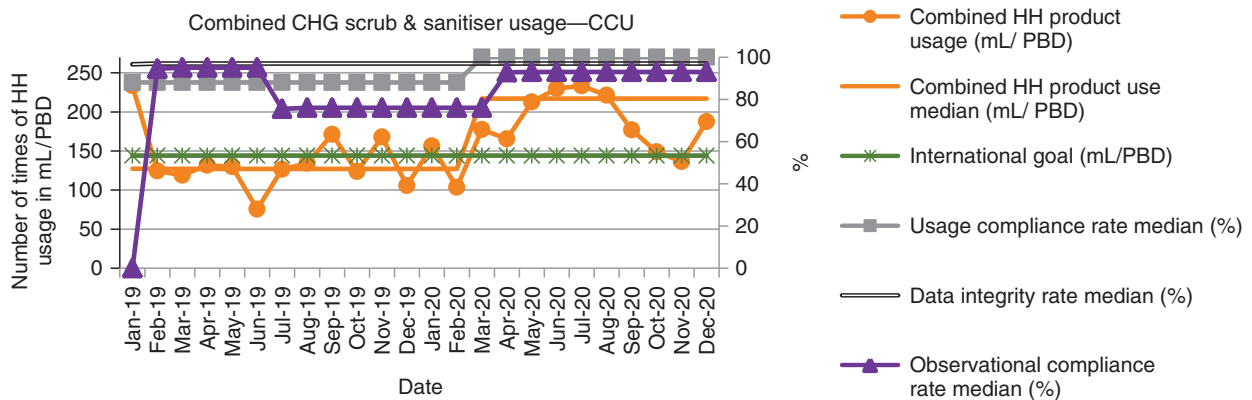
Figure 3 reflects the average combined CHG scrub and sanitiser product use of the two CCUs at the study hospital from January 2019 to December 2020. There was a significant increase in combined CHG scrub and sanitiser usage from March 2020 from 127 times of HH usage in mL/PBD to 217 times of HH usage in mL/PBD (71% increase). A run of four data points below the median could be seen from September 2020 onwards, with the December 2020 data point shifting upwards and moving closer to the median. Usage compliance to the international CCU goal (144 times of HH usage in mL/PBD) increased from 88% to 100%, also far exceeding the international goal for CCU. The median observational compliance rate decreased from 95% (January 2019 to June 2019) to 76% from July 2019 and increased again to 93% from April 2020. The median data integrity remained at 97% from January 2019.

The increase in HH usage in the CCU's from March 2020 was attributable to a significant median increase in CHG-AHR (102% from March 2020) as well as AHR (136% from March 2020). The CHG scrub median also increased by 40% from January 2020. All three HH products contributed to the combined HH product downwards run below the median from September 2020 to November 2020. In December 2020, the AHR data point moved closer to the median.

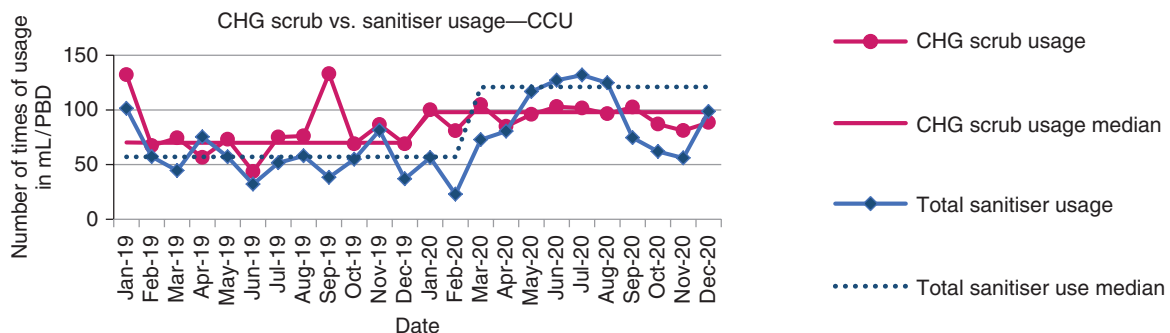
Figure 4 shows that the average CCU increase in sanitiser usage exceeded the increase in CHG scrub usage, with a median increase of 112% from March 2020 vs. 40% from January 2020, respectively. Both CHG scrub and sanitiser data points showed a run below the median from September (sanitiser usage) and from October (CHG scrub usage).

**Quantitative usage compliance rates vs. observational compliance rates**

Figure 5 highlights the usage vs. observational compliance rate medians for the different non-CCU nursing units. In four of the non-CCUs, the observational compliance exceeded that of the usage compliance preceding the pandemic, with varied changes following the onset of the



**Fig 3:** Combined CHG scrub and sanitiser usage – CCU



**Fig 4:** CHG scrub vs. sanitiser usage – CCU

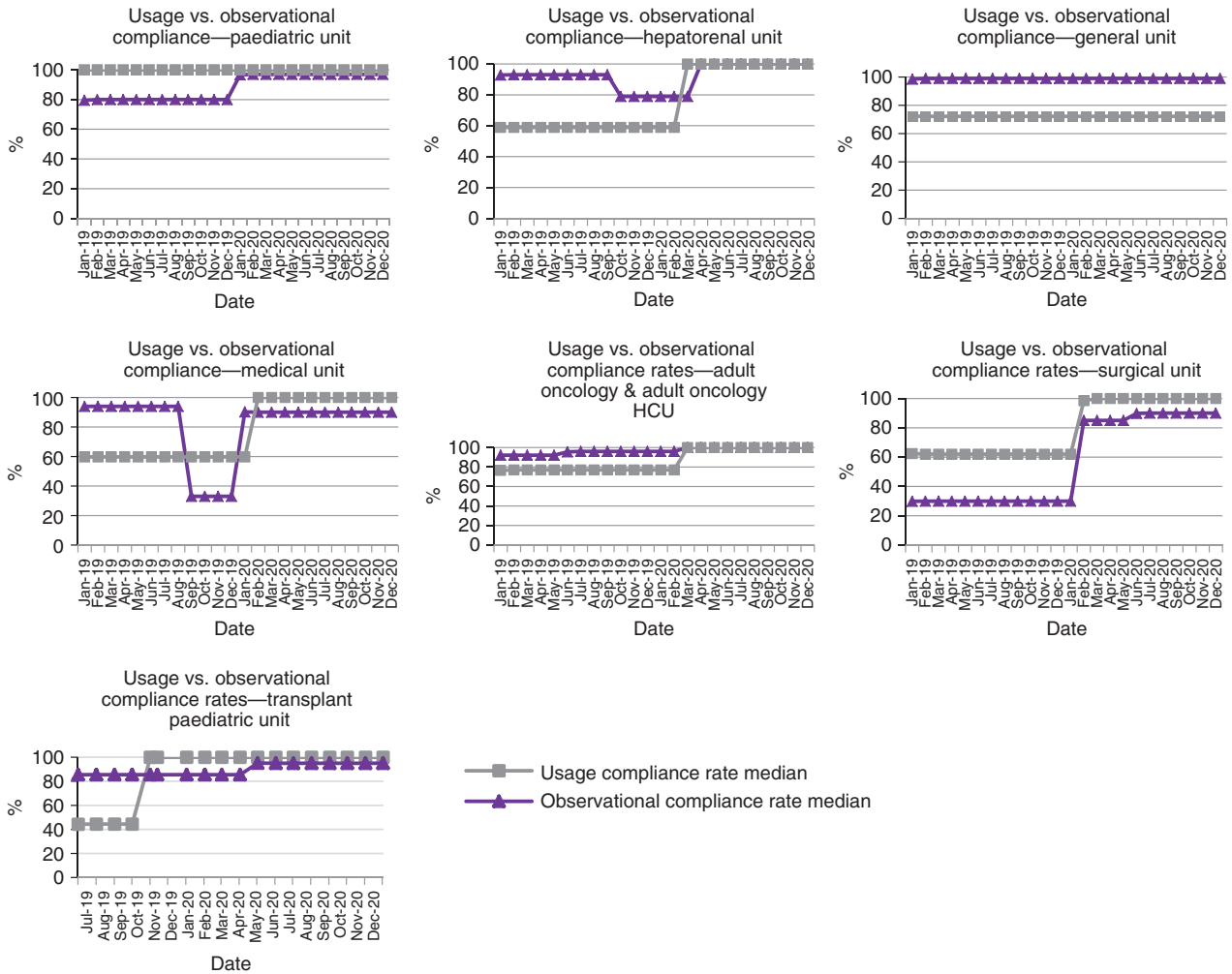


Fig 5: Usage vs. observational rate medians—non-ICU units

pandemic. Overall, there was a more modest increase in the observational compliance as compared to the usage compliance, with four units demonstrating a distinct increase in usage compliance coincident with the pandemic onset. In the CCUs, the two compliance rates showed a greater degree of concordance with increases seen for both usage and observational compliance at the onset of the pandemic.

**DISCUSSION**

This study provides insights into HH metrics, monitoring and performance at a hospital level during the COVID-19 pandemic. First, the quantitative usage of HH product increased dramatically with the onset of the pandemic and preparedness planning. An increase of 110% in non-CCU and 71% in CCU areas in usage per PBD meant that the predetermined targets of 72 and 144 mL/PBD were exceeded within a very short space of time. This increase was attributable to a greater usage of alcohol-based hand rub products, seen in both CCU and non-CCU areas.

Although not yet reflecting a change in the median, there was a trend towards a decrease in usage from September 2020 onwards, coinciding with the end of the first wave. A study assessing HH performance in nine US hospitals during the COVID-19 pandemic demonstrated a significant increase in HH performance at the onset of the pandemic, although this increase was also not sustained throughout the 10-week follow-up period.(6) This study utilised an automated HH monitoring system and thus is not directly comparable to our study.

No specific campaign to improve HH was introduced and this improvement in usage highlights two important points. First, the massive public awareness around non-pharmaceutical measures such as HH to prevent the spread of SARS-CoV-2 probably contributed to an increased awareness amongst HCWs. The motivation for such a sudden improvement in usage is intriguing as it may relate more to self-preservation of HCWs trying to reduce their own risk of infection, rather than an altruistic motive of limiting horizontal transmission. During



the COVID-19 pandemic, social and behavioural science reiterated that behaviour relating to non-pharmaceutical preventative measures like HH may be influenced by a combination of factors in the health-care setting, namely leadership, science communication and threat.(7) Threat comprises threat perception (a perception of the threat to oneself), and emotion and risk perception which entails one's knowledge of the benefits of certain behavioural choices for oneself and for society. A run below the median in combined HH product use seen from September 2020 (following the end of the first wave) and a subsequent increase again in December (start of second wave) highlights the potential influence of this threat factor. Pandemic fatigue is possibly another important contributory factor to reduced HH compliance following the first wave and subsequent waves. It is also possible that the intense media attention associated with each wave reinforced the importance of limiting transmission with a consequent increase in HCWs HH compliance.

According to a 2002 publication by the Centers for Disease Control and Prevention (8), interventions aimed at enhancing HH practice in health-care settings should target behavioural change by following recommendations based on behavioural theories.(9) Further studies are required to elucidate the determinants of the behavioural change seen during this pandemic.

A second important observation this study highlights is the discordance across units in HH usage compliance as compared to observational compliance. For many units, the observational compliance was already at a very stable and exceptional level pre-pandemic. The median observational compliance rate for non-CCU and CCU pre-pandemic was 74% and 76%, respectively. In a large national German HH compliance survey conducted in 2014, the median compliance was 72% and 74% in non-CCU's and CCU's, respectively.(10) In contrast to the marked increase in usage compliance rates in some units, the observed compliance rates demonstrated either a modest increase or remained relatively stable. This possibly illustrates the recognised limitations of HH observational compliance data, where many factors limit the reliability of this information.(11)

In terms of limitations, this study represents a longitudinal descriptive analysis of HH compliance, without an interrogation of the reasons behind the observed changes. Thus, all inferences with respect to the changes in HH compliance are speculative and require further study. Consumption does not correlate with appropriate use of product, and thus we cannot comment on the indications for use or the manner in which the product is used. We therefore also cannot make any inference on the impact of the increased HH compliance on infection rates within the hospital. We attributed the majority of the increased consumption to HCWs and not to ancillary staff and visitors. Visitation was substantially curtailed throughout the pandemic, so the impact of visitors on HH product usage was considered minimal and possibly even less usage in

comparison to a non-pandemic situation. Ancillary staff such as the cleaning, maintenance and kitchen staff account for a minority of the total staff component, and within the units themselves they are essentially visitors with sporadic and limited entry into cubicles. We acknowledge that some of the increased consumption could be attributed to non-HCWs but consider the impact overall negligible. The observational compliance data was drawn directly from the hospital audit system. It was not subject to audit and the integrity of the data not subject to scrutiny. This data is typically derived from periodic audits conducted by staff members within units or the IPC specialist. It is standard practice across hospitals to use this data in assessing compliance and thus represents the reality of HH monitoring. It must be noted that observational compliance data is to some extent subjective, depending on the level of training, the variability in application of standardised definitions, and the timing and duration of audits.(11) This may be reflected in the inconsistency of the observational data across units as compared to the usage data.

## CONCLUSION

We have demonstrated a significant increase in HH product usage by HCW within a hospital setting during the first wave of the COVID-19 pandemic. This improvement shows discordance with observed compliance rates and raises questions as to the validity of monitoring HH compliance by observational methodology alone. Understanding the motivation behind this behavioural change is an important research question as it could aid in the development of strategies to improve and sustain HH compliance.

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