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Posted Date: 29 September 2023

doi: 10.20944/preprints202309.2063.v1

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Article

# Understanding the Knowledge, Attitudes, and Practices of Hand Hygiene, Wearing Mask, and Social Distancing among the Public Hospital and Polyclinic Nurses in Barbados Amid the COVID-19 Pandemic

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**Abstract: Background:** Nurses are essential members of the healthcare workforce and were among the first line carers for patients in community and hospital settings during the COVID-19 pandemic. As a result, they were at a heightened risk of contracting the disease, resulting in a significant number of reported deaths among them. Several preventive measures were adopted to contain the spread of this potentially lethal virus. This study aims to explore the knowledge, attitudes, and practices (KAP) of nurses regarding hand hygiene, mask wearing, and social distancing measures in healthcare settings in Barbados during the COVID-19 pandemic. **Method:** An online survey of nurses working in public hospitals and polyclinics (public primary care clinics) of Barbados from December 2020 to July 2021, was conducted. Participants completed a questionnaire capturing socio-demographic information and knowledge and practices related to hand hygiene, using face masks, and social distancing. Each correct response received one mark. Overall knowledge scores were categorized as poor (<60%), average (60-80%), or good (>80-100%). **Results:** Of 192 participants, the majority were female (82.8%) and had >5 years of experience (82%). Findings revealed that 45.8% had poor knowledge of hand hygiene, and the knowledge of 43.8% of respondents was average. Multivariable logistic regression showed that, after adjustment for age and gender, registered nurses had 2.1 times increased odds (95% CI 1.0, 4.2) of having good knowledge compared to other nursing categories. Regarding mask-wearing, 53.6% of nurses had average and 27.1% had good knowledge. Multivariable logistic regression showed that, after adjustment for age and gender, registered nurses had 3.3 times increased odds (95% CI 1.5, 7.4) of having good knowledge compared to nursing assistants. 68.6% of respondents followed the correct steps of handwashing every time, and 98.3% wore a mask in public places. More than half of the nurses (51.2%) kept a safe distance from others to avoid spreading SARS-CoV-2; one-third were in a crowded place(s) in the past three months, and 55.8% usually followed guidelines for social isolation as recommended by WHO. **Conclusion:** The study identified knowledge deficiencies related to hand hygiene and wearing masks among nurses. It is imperative to provide additional training on infection control measures.

**Keywords:** COVID-19 pandemic; Nurses; Hand washing; Mask-wearing; Social distancing

## 1. Introduction

The coronavirus-2019 (COVID-19) pandemic has caused challenges for researchers and healthcare professionals worldwide. As of 11th April, 2023, the COVID-19 pandemic has caused more than 685 million infections and more than 6.8 million deaths globally (1). An estimated 80,000 to

180,000 healthcare workers died worldwide from COVID-19 between January 2020 and May 2021 (2). These statistics highlighted the importance of effective measures to mitigate the spread of the virus. Vaccines against SARS-CoV-2 have been developed by scientists at an unprecedented pace. While COVID-19 vaccines have been shown to prevent illness effectively, it remains unclear whether they can effectively prevent transmission (3). Fully vaccinated individuals may have the potential to transmit the virus, even without exhibiting symptoms. Therefore, it is imperative to implement effective and simple preventive measures to reduce risk of transmission of the virus within the community. It is also critical to investigate the knowledge, attitudes, and practices (KAP) of healthcare professionals, particularly nurses, in observing essential infection control procedures as the world community continues to fight the pandemic (4).

The World Health Organization (WHO) has recommended several hygiene measures and behavioral guidelines to safeguard the public from COVID-19 (5, 6), including wearing masks, maintaining a safe physical distance, and sanitizing hands. All these are cost-effective interventions effective in reducing the risk of transmission (7). Assessment of knowledge, attitudes, and practices is essential to implement behavioral change (8). This assessment reflects baseline information and provides insight to address ignorance and misconceptions involved in practices for the prevention of diseases. The literature emphasizes the need to adapt preventive guidelines to minimize the transmission of the infection and prevent deaths (9).

Barbados has adopted multiple strategies to combat the COVID-19 epidemic (10). The rapid and broad deployment of COVID-19 vaccinations has been an important strategy. However, vaccinations plateaued at about 57%, and vaccine hesitancy has been a barrier to further uptake (11). Certainly availability of vaccines does not eliminate the need for putting non-pharmaceutical interventions (NPIs) and hygiene precautions into place. Even with the implementation of vaccination programs, certain precautions, such as hand hygiene, mask use, and social isolation, are still essential in minimizing the transmission of COVID-19 (12).

As frontline caregivers for patients in the healthcare system during the COVID-19 epidemic, nurses have played a crucial role in public health response and are at considerably higher risk than the general population. (13). In order to prevent the spread of the virus inside healthcare environments nurses must strictly apply NPIs (14). It is possible to identify areas for improvement and create tailored interventions that address particular issues experienced by nurses in Barbados by comprehending the KAP of nurses about hand cleanliness, mask use, and social distance.

As nurses frequently interact with severely ill patients, their hands can pose a significant risk of transmitting infection during routine caregiving tasks such as touching and handling instruments (15, 16). The pandemic has necessitated the active involvement of nurses in clinical monitoring and management, public safety, and awareness. Nurses' lack of knowledge regarding sub-optimal hygiene practices threatens overall quality of healthcare and, more specifically, increases risk of transmission of COVID-19 in hospitals and the community (17). Proper hand hygiene is the simplest and most effective measure for preventing nosocomial infections and fatalities among healthcare workers (18, 19). Further, existing studies have shown that the spread of acute respiratory syndrome (SARS) was reduced by improving the technique of hand washing (14).

During the COVID-19 pandemic, one of the accepted measures worldwide in infection control measures is the use of a face mask besides hand hygiene. Face masks have been recommended as a low-cost preventive measure to reduce virus transmission (20). The appropriate use of face masks is particularly crucial, especially during this COVID time, as a preventive measure (21). This is particularly crucial due to the potential for pre-symptomatic and asymptomatic individuals to unknowingly transmit the virus. (20). COVID-19 spreads primarily through direct contact and respiratory droplets (22, 23). Face masks work by providing a physical barrier between the mouth and nose of the wearer and potential contaminants in the immediate environment (21, 24).

The implementation of social distancing measures during severe acute respiratory syndrome [SARS] and swine flu [H1N1] effectively controlled the spread. Transmission of COVID-19 can occur through direct, indirect, or close contact with secretions, such as respiratory secretions or respiratory droplets. A definite decline in cases of COVID-19 was reported after the use of masks. COVID-19

spreads primarily through contact routes and respiratory droplets (22, 23). However, social distancing reduces productivity and can significantly impact the mental health of the participants (25). Social distancing measures include avoiding travel, limiting physical contact with people outside of one's household, and maintaining two meters or more to prevent the spread of the SARS-CoV-2 virus. These are primary and remarkably effective strategies to prevent the transmission of COVID-19 (26).

Given the pivotal role of nurses in infection control, it is imperative to understand their knowledge, attitudes, and practices regarding NPIs in varied practice contexts. This study, therefore, aimed to assess the knowledge, attitudes, and practices of nurses regarding hand hygiene, mask use, and social distancing measures in healthcare settings in Barbados during the COVID-19 pandemic. By highlighting the importance of NPIs and hygiene measures, the study sought to provide findings useful for improving infection control strategies to protect the well-being of healthcare professionals and the public in Barbados. These findings may contribute to developing targeted interventions to improve adherence to NPIs among nurses, thereby enhancing effectiveness of infection control in the context of COVID-19 and other pathogens.

## 2. Material and Methods

### 2.1. Study design:

A cross-sectional study of nurses (registered nurses, nursing assistants and midwives) employed at various hospitals and public primary care clinics in Barbados was conducted during the COVID-19 pandemic. The data were gathered via an online REDCap survey link distributed from mid-March to October 2021.

### 2.2. Study setting:

Participants included nursing staff from the following public healthcare facilities in Barbados: (a) Queen Elizabeth Hospital (QEH) (lone tertiary hospital), (b) Geriatric Hospital (St. Michael District Hospital - main residential geriatric facility), (c) Psychiatric Hospital, and (d) Branford Taitt Polyclinic (public primary care clinic - second largest in terms of population served).

### 2.3. Recruitment of the Study Participants:

All nurses working at the above-mentioned healthcare facilities were eligible for inclusion in the study. A convenience sampling method was employed to recruit the participants. Those who consented to participate were enrolled sequentially.

### 2.4. Study instruments:

The study utilized a pre-tested, self-administered questionnaire (27) consisting of the following sections:

*Demographics:* Demographic details included age, gender, marital status, hospital, job characteristics, formal training, and education level.

*Hand Hygiene:*

a. *Knowledge of hand hygiene:* The WHO Hand Hygiene Knowledge Questionnaire (27) was employed to evaluate: 1) hygiene knowledge training, main routes of cross-transmission, the most frequent source of germs responsible for infections, and prevention of germ transmission; and 2) the minimal time needed for hand rub, and methods to avoid harmful colonization of pathogens on the hands.

Ten items were used to assess hand hygiene knowledge. For each correct response, participants were given 1 point. Participants' scores were summarised and categorised. Overall knowledge scores were categorized as poor (<60%), moderate (60-80%), or good (80-100%).

We examined predictors of hand hygiene knowledge using bivariate analysis. The main outcome was hand hygiene knowledge and independent predictors were age, gender, educational

level (bachelor's degree or higher versus associate degree/certificate) and category of nurse (registered nurse or not). Multivariable logistic regression using age and gender were performed to adjust for potential confounding of relationship between hand hygiene knowledge and category of nurse.

b. *Hand hygiene practice and attitudes*: Eight questions were utilized to evaluate individuals' practice and attitude towards hand washing. The overall knowledge was then classified into three categories: poor, moderate, and good.

Mask-wearing:

*Knowledge and practice of mask-wearing*: A questionnaire developed by Kumar et al. (28) was used to assess knowledge and practice of mask-wearing. Each correct answer scored 1 and each incorrect answer scored 0. The total number of questions was 9, and the final score was calculated and then labelled according to the percentage (out of 9) of correct responses as good (>80%), moderate (60-80%), and poor (<60%).

We examined predictors of mask-wearing knowledge using bivariate analysis. The independent predictors were age, gender, educational level (bachelor's degree or higher versus associate degree/certificate), and category of nurse (registered or not). Multivariable logistic regression using age and gender was performed to adjust for potential confounding of relationship between mask-wearing knowledge and category of nurse.

Social Distancing:

Practice of social distancing: This section consisted of 7 questions. Five questions were taken from a questionnaire used by Al-Hanawi et al. (25, 29)(Ref). The researchers added two questions to elicit additional information on social distancing practices.

### 2.5. Statistical analysis:

The Statistical Package for the Social Sciences (SPSS) version 25.0 was used to analyze the data. Descriptive statistics were used to summarize demographic variables. For the knowledge, perceptions, and practice items, means and standard deviations were reported. Inferential statistics were performed to examine the predictors of hand hygiene knowledge and mask-wearing using bivariate analysis. Multivariable logistic regression using age and gender was performed to adjust for potential confounding of the relationship between hand hygiene knowledge and category of nurse.

### 2.6. Ethical approval:

The study protocol was approved by The University of the West Indies, Barbados Ministry of Health Research Ethics Committee/Institutional Review Board (IRB) (IRB no: 210202). Prior to participation, written consent was obtained from all participants, and the study adhered to the principles outlined in the Declaration of Helsinki.

## 3. Results

### 3.1. Demographics of the respondents

Table 1 presents the demographic characteristics of the respondents. The study involved 192 nurses in Barbados, with a mean age of 40.0 years (SD  $\pm$ 10.4). Females comprised the majority (82.8%) of the participants, while males made up 17.2%. In terms of qualifications, 44.8% of the nurses possessed graduate-level qualifications, while another 44.8% held associate degrees/certificates. Additionally, out of the total number of nurses, 157 (81.8%) had accumulated more than five years of experience, while 35 (18.2%) had less than five years of experience. The majority of the participants were registered nurses (76.6%), followed by assistant nurses (18.2%) and midwives (12.0%).

**Table 1.** Demographic data of the respondents.

Variable	Frequency	%
<i>Age (years)</i>		
15-25	8	4.2
26-35	67	34.9
36-45	54	28.1
46-55	28	14.6
≥55	23	11.9
<i>Gender</i>		
Females	159	82.8
Males	33	17.2
<i>Education</i>		
PhD	2	1.0
Master's degree	15	7.8
Associate degree	76	39.5
Bachelor's degree	66	34.4
Certificate	30	15.6
<i>Profession</i>		
Registered nurse	147	76.6
Midwife	23	12
Nursing assistant	35	18.2
<i>Department</i>		
ICU	17	8.9
Paediatrics	11	5.7
Internal Medicine	6	3.1
Geriatric	11	5.7
Surgery	26	13.5
Obstetrics	13	6.8
Psychiatry	46	24
Medicine	21	11
Emergency	4	2.1
Outpatient Clinic	8	4.2
Other	25	13
<i>Did you receive formal training in hand hygiene in the last three (3) years?</i>		
Yes	152	79.2
No	35	18.2

### 3.2. Findings of hand hygiene

#### 3.2.1. Knowledge of hand hygiene

Findings indicated that 45.8% of nurses had poor knowledge of hand hygiene, 43.8% had moderate knowledge, and 10.4% had good knowledge. Approximately 62% of participants demonstrated knowledge of primary routes of cross-transmission of germs between patients when their hands were not clean. 36.6% of nurses indicated that germs already present on or within the patient are the primary source of healthcare-associated infections. Approximately 93.8% of nurses acknowledged that practicing hand hygiene prevented the transmission of germs before encountering a patient. Further, a significant majority of participants, 86.5% and 63% respectively, acknowledged the importance of avoiding artificial fingernails and damaged skin due to their association with an increased risk of harmful germ colonization on the hands (Table 2).

**Table 2.** Knowledge of hand hygiene in nurses.

Knowledge items	Frequency Percent	
	Frequency	Percent
<b>Which of the following is the main route of cross-transmission of potentially harmful germs between patients in a healthcare facility?</b>		
Healthcare workers' hands when not clean (Yes)	114	62.0
Air circulating in the hospital (No)	2	1.1
Patients' exposure to colonised surfaces (i.e., beds, chairs, tables, floors) (No)	28	15.2
Sharing non-invasive objects (i.e., stethoscopes, pressure cuffs, etc.) between patients (No)	40	21.7
<b>What is the most frequent source of harmful pathogens responsible for healthcare-associated infections?</b>		
Pathogens already present on or within the patient (Yes)	67	36.6
The ventilation system within the hospital (No)	7	3.8
The hospital environment (No)	109	59.6
<b>Which of the following hand hygiene actions prevents transmission of germs to the patient?</b>		
Before touching a patient (Yes)	180	93.8
Immediately after the risk of body fluid exposure (No)	108	56.2
After exposure to the immediate surroundings of a patient (No)	101	52.6
Immediately before a clean/aseptic procedure (Yes)	127	66.2
<b>Which of the following hand hygiene actions prevents transmission of germs to the healthcare worker?</b>		
After touching a patient (Yes)	171	89.1
Immediately after the risk of body fluid exposure (Yes)	136	70.8
Immediately before a clean/aseptic procedure (No)	128	66.7
After exposure to the immediate surroundings of a patient (Yes)	89	46.4
<b>Which of the following statements on alcohol-based hand rub and handwashing with soap and water are true?</b>		
Hand rubbing is more rapid for hand cleansing than handwashing (True)	75	39.1
Hand rubbing causes skin dryness more than handwashing (False)	60	31.2
Hand rubbing is more effective against germs than handwashing (True)	13	6.8
Handwashing and hand rubbing are recommended to be performed in sequence (False)	127	66.2
The minimal time needed for an alcohol-based hand rub to kill most germs on your hands (20 Seconds)	77	40.1
<b>Which of the following should be avoided, as associated with increased likelihood of colonisation of hands with harmful germs?</b>		
Wearing jewelry (Yes)	166	86.5
Damaged skin (Yes)	121	63.0
Artificial fingernails (Yes)	173	90.1
Regular use of a hand cream (No)	27	14.1

### 3.2.2. Practices and attitude of hand hygiene

Based on the responses of participants, Table 3 presents information regarding hand hygiene practices in a clinical setting. A substantial majority of participants (85.9%) reported adhering to hand hygiene practices by washing their hands before touching a patient, between caring for individual patients, and immediately after completing a clean aseptic procedure. Hand washing with soap and water emerged as the preferred hand hygiene procedure among the participants. More than 90% of the participants reported washing their hands more than 10 times while in the clinical setting. However, only around 69% of the participants reported completing all the correct handwashing steps

every time. Only about one-third of the participants reported washing their hands after touching a clean surface.

**Table 3.** Practice and attitude of hand hygiene.

Practice items	Frequency	Percent
<b>In which of the following clinical situations do you wash your hands?</b>		
Before touching a patient	165	85.9
Between caring for individual patients	165	85.9
Immediately before commencing a clean aseptic procedure	175	91.2
Immediately after completing a clean aseptic procedure	165	85.9
<b>In which of the following clinical situations do you wash your hands?</b>		
After touching a clean surface in the clinical area	63	32.8
Other	27	14.1
<b>How often do you wash your hands while in the clinical setting?</b>		
>10 times	171	91.4
6-9 times	12	6.4
3-5 times	4	2.1
Do you complete all of the correct steps of the handwashing process every time?	129	68.6
<b>Which of the following procedures do you prefer to use in the clinical setting?</b>		
Hand Washing with soap and water	182	97.3
Rubbing with alcohol	5	2.7

### 3.2.3. Predictors of hand hygiene knowledge

Multivariable logistic regression showed that after adjustment for age and gender, registered nurses had 2.1 times increased odds (95% CI 1.0, 4.2) of having good knowledge compared to other nursing categories (Table 4).

**Table 4.** Predictors of hand hygiene knowledge.

Characteristics	Moderate/Good knowledge, n (%)	p-value
Male, n=33	16 (48.5%)	P=0.472
Female, n=159	88 (55.4%)	
Bachelor's Degree or higher, n=86	51 (59.3%)	P=0.198
Associate degree/Certificate, n=106	53 (50.0%)	
Greater than 5 years' experience, n=157	85 (54.1%)	P=0.988
Less than 5 years' experience, n=35	19 (54.3%)	
Registered Nurse, n=147	86 (58.5%)	P=0.029
Nursing Assistant, n=45	18 (40.0%)	

### 3.3. Findings of mask wearing

#### 3.3.1. Knowledge of mask wearing

Regarding wearing masks, 53.6% of nurses had moderate knowledge, 27.1% had good knowledge, and 19.3% had poor knowledge. More than 95% knew the correct way of wearing a surgical mask, 79.2% knew that there are three layers in a surgical mask, and 80.1% knew how to identify the correct filter media barrier. Moreover, 88.3% of participants knew that surgical masks were effective against COVID-19, while only 6.3% were aware of the maximum duration of wearing a face mask. When asked about the extent to which a surgical mask should cover, 92% answered correctly, and all the respondents correctly reported the purpose of the metal strip (Table 5).

Table 5. Knowledge of mask-wearing.

Knowledge items	Correct answer	
	Frequency	Percent
<b>Which is the correct way of using a surgical face mask to protect against COVID-19</b>		
White side facing out	8	4.6
White side facing in (Correct)	166	95.4
<b>How many layers are there in a surgical mask?</b>		
Two	33	19.1
Three (Correct)	137	79.2
Four	3	1.7
<b>Can wearing a surgical mask protect you from COVID-19?</b>		
Yes (Correct)	151	88.3
No	20	11.7
<b>Which layer acts as a filter media barrier?</b>		
First layer	29	17.0
Middle layer (Correct)	137	80.1
Last layer	5	2.9
<b>Which type of masks actually protect against COVID-19?</b>		
97% BFE and PFE	54	34.8
95% BFE and PFE (Correct)	99	63.9
91% BFE and PFE	2	1.3
<b>How long can you wear a surgical mask?</b>		
1 hour	4	2.3
2 hours	16	9.2
4 hours	143	82.2
8 hours (Correct)	11	6.3
<b>For proper wearing, to which extent should the surgical mask cover?</b>		
Nose only	0	0
Nose and mouth	14	8.0
Nose, mouth and chin (Correct)	160	92.0
<b>What is the purpose of the metal strip on a surgical mask?</b>		
To fit on the nose (Correct)	173	100
To fit on the chin	0	0
<b>Is the cloth facial mask as effective as a regular surgical facial mask?</b>		
Yes	19	11.1
No (Correct)	152	88.9

### 3.3.2. Practice and attitude of mask-wearing

Majority of the participants, reported removing their masks when there is a need to talk to the patient during clinic time (98.3%), do not store the used surgical mask in a bag for later use (97.7%), and wearing a mask in public places to protect themselves against COVID-19 (98.3%). The red-coded bag was the most frequently reported choice for disposing masks, with 82.0% of the participants indicating its usage. The black-coded bag was the second most reported choice, with 14.5% of the participants reporting its use (Table 6).

**Table 6.** Practice and attitude of mask-wearing.

Practice items	Frequency	Percent
<b>During clinics, if there is a need to talk to the patient, do you remove your mask?</b>		
Yes	170	98.3
No	3	1.7
<b>If you are not sick, do you store the used surgical mask in a bag for later use?</b>		
Yes	4	2.3
No	169	97.7
<b>Do you wear a mask in public places to protect yourself against COVID-19?</b>		
Yes	170	98.3
No	3	1.7
<b>In which color-coded bag do you dispose of your mask?</b>		
Red-coded bag	141	82.0
Yellow- coded bag	4	2.3
Black- coded bag	25	14.5
Blue- coded bag	2	1.2

### 3.3.3. Predictors of mask wearing knowledge

Multivariable logistic regression showed that after adjustment for age and gender, registered nurses had 3.3 times increased odds (95% CI 1.5, 7.4) of having good knowledge compared to other nursing categories (Table 7).

**Table 7.** Predictors of mask wearing knowledge.

Characteristics	Moderate/Good mask wearing knowledge, n (%)	p-value
Male, n=33	28 (84.8)	P=0.510
Female, n=159	127 (79.9)	
Bachelor's Degree or higher, n=86	71 (82.6)	P=0.563
Associate degree/Certificate, n=106	84 (79.2)	
Greater than 5 years' experience, n=157	125 (79.6)	P=0.408
Less than 5 years' experience, n=35	30 (85.7)	
Registered Nurse, n=147	126 (85.7)	P=0.002
Nursing Assistant, n=45	29 (64.4)	

### 3.4. Findings of social distancing

#### 3.4.1. Practice of social distancing

An overwhelming majority of participants, exceeding 98%, reported actively practicing social distancing. Many of the participants reported avoiding cultural behaviours, such as shaking hands (92.7%) and washing their hands with soap and water for at least 40 seconds, especially after going to a public place or after sneezing, coughing, or blowing their nose (90.8%). A minority of participants (12.2%) disclosed their involvement with more than 20 people or visiting crowded places. However, a significant majority of participants reported adhering closely to social isolation guidelines, with 55.8% mostly following the rules and 43.6% strictly abiding by them (Table 8).

**Table 8.** Practice of social distancing.

Social distancing items	Frequency	Percent
<b>Do you keep your distance from others to avoid spreading SARS-CoV-2?</b>		
Yes all	84	51.2
Yes sometimes	77	47.0

	No	3	1.8
Have you, in the past 3 months, been to a social event involving more than 20 people?		20	12.2
Have you, in the past 3 months, been to a crowded place?		54	33.3
Have you, in the past 3 months, avoided cultural behaviors, such as shaking hands?		152	92.7
Have you been practicing social distancing?		162	98.8
Recently, have you washed your hands with soap and water, for at least 40 seconds, especially after going to a public place, or after 2se-blowing, coughing, or sneezing?			
	Yes	148	90.8
	No	15	9.2
Do you closely follow social isolation rules?			
	Yes mostly	91	55.8
	Yes strictly	71	43.6
	No	1	0.6

#### 4. Discussion

This study aimed to explore potential determinants of nurses' knowledge, attitudes, and practices concerning the proper wearing of masks and hand hygiene and social distancing measures in various healthcare settings during the COVID-19 pandemic in Barbados. The purpose of conducting KAP assessments among public hospital and polyclinic nurses in Barbados was to gain insights into their KAP regarding hand hygiene, mask-wearing, and social distancing. This assessment would provide a rationale for targeted interventions, educational campaigns, and training programs aimed at enhancing adherence to these infection control measures. The findings of this study would contribute to the development of targeted interventions to improve adherence to NPIs among nurses, thereby enhancing their protection and the overall control of the pandemic.

##### 4.1. Hand Hygiene:

It is widely recognized that enhancing hand hygiene compliance among healthcare workers significantly reduces spread of the COVID-19 infections. Several researchers strongly indicated that maintaining proper hand hygiene is the most effective way to prevent the spread of COVID-19 infection together with other protective measures such as wearing masks and practicing social distancing (5, 6). Most of the respondents in our study believed that cross-transmission of potentially harmful germs occurs due to poor hand hygiene.

This is supported by findings of a study conducted by Shariff et al. (30, 31) which concluded that nosocomial infections are propagated due to inadequate hand hygiene. Our research indicates that most participants knew that jewelry and rings should be removed before handwashing (86.5%) as they can harbour harmful microorganisms and that artificial fingernails are a common source of germs (90.1%). Similarly, Siaman et al. (32) reported nosocomial infection outbreaks caused by gram-negative bacilli such as *Pseudomonas aeruginosa*, with a correlation being drawn between artificial nails and these outbreaks. This study reveals that 89.1% respondents believe that proper hand hygiene technique after patient contact can prevent infection transmission and 89.5% of respondents use their hands before touching a patient. Our finding is much higher than the findings reported by Sharif A. et al. (30), where 66.2% agreed that hands should be washed before any procedure or patient contact. Of note, also a study conducted during the COVID-19 pandemic in 20 nursing homes in Norway reported adequate hand hygiene adherence among nursing students and nurses (33) (Ref). However, low compliance was observed among healthcare workers during the COVID-19 pandemic in a tertiary care hospital in India which may be due to a lack of knowledge and awareness (34). Another study conducted in 228 outpatient settings in Tanzania before the COVID-19 pandemic reported that HCWs' hand hygiene and disinfection compliance was inadequate (35). There is a need to enhance

the knowledge and practice of nurses regarding hand hygiene, and they should act as the "role models" for good hand hygiene (36).

In order to prevent the spread of COVID-19 viruses, the Centers for Disease Control and Prevention (CDC) (37) and World Health Organization (38) recommended practicing frequent hand washing with soap and water. Handwashing frequency in clinical settings is found to be >10 times (91.4%) in the present study. A study conducted by Dwipayanti et al. (39) among the general population in Indonesia found that majority of the respondents practice handwashing 8 times or more per day during COVID-19 pandemic. A study conducted in the USA during the first week of the COVID-19 pandemic reported that respondents showed increased awareness of risk and engaged in protective behaviours with increasing frequency e.g., practicing handwashing more frequently than usual (40). Additionally, our research demonstrates that 42.1% of the respondents agreed that rubbing hands with alcohol-based sanitizer for a minimum of 20 seconds is sufficient to kill harmful germs. In contrast, Shariff et al. (30) reported that 78.5% of respondents believed a minimum of 60 seconds of rubbing is necessary to eliminate germs.

The knowledge regarding alcohol-based hand rubbing among the nurses in our study was inadequate. For example, only 39.1% of respondents correctly responded that hand rubbing was more rapid for hand cleansing than handwashing, and 66.1% believed that handwashing and hand rubbing were recommended to be performed in sequence, which is an incorrect answer. Of great concern is the fact that only 6.8% of participants acknowledged that hand rubbing is more effective against germs than handwashing (correct answer). It is imperative that healthcare providers take these findings seriously and undertake appropriate training in response. In a study conducted by Sharif et al.'s (30), 78% of respondents indicated that rubbing hands with alcohol-based soap is effective in killing bacteria. CDC also recommended using an alcohol-based hand rub that contains 60% alcohol if soap and water are not available (41).

#### 4.2. Mask wearing:

The application of face masks while dealing with patients by healthcare teams as a preventive measure against infection transmission has been strongly advocated by the World Health Organization (WHO) (42, 43). The face masks form an essential component of appropriate personal protective equipment (PPE), and it is of utmost importance to ensure their correct usage to achieve optimal protection against infections (44). The implementation of preventive strategies, such as social distancing and remote work, poses challenges for nursing staff (45). Unlike other healthcare professionals, they are required to be present at patients' bedsides for extended periods. Consequently, it becomes crucial to prioritize the provision of personal protective equipment (PPE) to nursing staff (12, 45). This includes essential items like gloves, eyewear, surgical face masks (SFM), and filtering face piece masks (FFP masks), as the virus can spread through contact or droplet transmission. The utilization of masks is crucial in safeguarding frontline workers, particularly nursing staff (46).

In the present study, more than half of the respondents (53.6%) had moderate knowledge related to mask-wearing during the COVID-19 pandemic. A study conducted Kumar et al. in Pakistan, using the same questionnaire, revealed that the level of knowledge regarding face mask usage was found to be moderate among 45.6% of the HCWs which the authors termed as 'inadequate' (28). The study included male nurses (86.9%) However, our study consisted of a higher proportion of female nurses, accounting for 82.8% of the participants. During the COVID-19 pandemic, a study revealed that female nurses (55.8%) exhibited satisfactory knowledge regarding proper techniques for utilizing face masks among Egyptian healthcare workers. (47).

According to the findings of the current study, a significant percentage of participants (88.3%) acknowledged that wearing masks can effectively safeguard against COVID-19 infection. Furthermore, a substantial majority (95.4%) demonstrated awareness of the correct method for wearing masks. These findings are much higher than the responses of Kumar et al. study, 70.9% and 43.6% respectively. However, a study conducted in Egypt found that a minority of nurses (19.2%) belief that wearing a surgical mask could effectively reduce the risk of contracting COVID-19

infection (48). Current research indicates that the best protection is provided by a 95% BFE and PFE (63.9%) (correct answer) and masks should be multi-layered, with the middle layer of a surgical mask being the most protective (80.1%) (correct answer). Kumar et al. reported the following findings - best protection with 95% BFE and PFE: 64.8% and middle layer of a surgical mask: 53%.

Our study reported that 88.9% of participants consider cloth masks ineffective. This finding is consistent with studies conducted by other researchers (49-51) which demonstrated that cloth masks are one-third less effective than medical masks. According to several studies (Refs), it has been reported that only a quarter of respondents utilize cloth or paper masks while in the office, despite the majority of individuals believing in the effectiveness of cloth masks. As research findings suggest that cloth masks play a crucial role in acting as a barrier and reducing the risk of COVID-19 virus exposure, these findings highlight the importance of implementing training programs to educate both HCWs and the general population about effective infection control measures and the correct usage of face masks (47). Comprehensive training plays a vital role in raising awareness and ensuring that individuals comprehend the importance of proper mask usage in reducing the transmission of life-threatening viruses.

In this study, 98.3% of participants wore a mask in public to protect against COVID-19 which is higher than the study conducted by Kumar et al. (93.8%). A study conducted in Saudi Arabia found the overall mask adherence of 82% among HCWs (52). Another study reported the mask adherence of 89% among nurses in Canada (53). Numerous studies have consistently demonstrated a strong correlation between the use of masks and (54-58). A study conducted in all 50 states of the USA revealed that states with higher levels of mask adherence were significantly less likely to experience elevated COVID-19 rates. For example, eight states with a mask adherence rate of 75% or higher, reported a low prevalence of COVID-19 cases – 109.26 per 100,000 individuals (about the seating capacity of the Los Angeles Memorial Coliseum) in states with at least 75% mask adherence in contrast to 249.99 per 100,000 for states with lower adherence levels (59).

#### *4.3. Social distancing:*

In this study, 98.8% of participants adhered to social distancing guidelines, with 51.2% indicating that they maintained a safe distance to avoid exposure. Comparable results were reported by Gratz et al. (26), where 31.3% of respondents followed social distancing guidelines. The finding of the present study is a cause for concern, as it indicates that less than half of the respondents (43.6%) strictly followed the guidelines for social isolation. A study conducted by El-Ghitany et al. found that 40% of nurses in Egypt usually practice social distancing during the pandemic (60).

It must be noted also that consideration should be given to the fact that nurses as key frontline workers would not have been subject to the strict isolation rules associated with the COVID-19 lockdowns and continue to deliver care in the various health institutions which may have resulted in the low percentage of participants in this study who observed the rules of social isolation. However, in this study, 92.7% of respondents indicated that they avoided cultural behaviours such as shaking hands. This finding is consistent with the results of a study conducted by Mohamed et al (2020) in which 87% of persons surveyed agreed with this practice. Similarly, both studies are congruent with respect to most persons following practices of social distancing related to COVID-19. Another concern is that both surveys were distributed during the height of the COVID-19 disease outbreak at a time when there were government instituted guidelines for social distancing as well as public awareness campaigns. This is a position which is supported as well by Mohamed et al (2020) which indicated that persons' knowledge in this area may be attributed to the vigorous public awareness campaigns presented by the authorities to manage the pandemic.

Nurses have been instrumental in delivering patient care and healthcare during the COVID-19 pandemic. Due to their constant contact with infected people, they were at a higher risk of contracting the virus. Maintaining social distancing within hospitals across various clinical settings is crucial to safeguard the health and well-being of the nurses and other HCWs during the pandemic (61). Moreover, by following the norms of social distancing, nurses prioritize their own safety, stop the transmission of disease, set an example, support mental health, and improve the general health of

their communities. To effectively limit the spread of COVID-19, it is critical for nurses and healthcare organizations to emphasize and promote social distancing.

#### 4.4. Limitations of the study

This study is subject to limitations, including a sample size of 285 participants and incomplete questionnaire filling. The online mode of the survey, which yielded low responses, was another limitation of the study. Furthermore, the diverse range of responses to the questions has led to some discrepancies and variations in the results obtained.

#### 5. Conclusions:

The findings of the study indicated that nurses showed good knowledge of hand hygiene and correctly identified the primary route of cross-transmission of harmful germs between patients. However, certain knowledge gaps were observed, particularly concerning the utilization of alcohol-based hand rubs and the potential risk associated with artificial fingernails in terms of hand colonization by harmful germs. Likewise, a significant majority of nurses demonstrated recognition of the appropriate method for utilizing a surgical mask as a means of protection against COVID-19. Nonetheless, there were some gaps observed concerning the types of masks that offer adequate protection against COVID-19 and the recommended duration for wearing a surgical mask. The study emphasizes the necessity for continuous education and training to enhance the knowledge and adherence to hand hygiene and mask-wearing practices among healthcare workers.

**Funding statement:** The authors received no funding for this work.

**Acknowledgments:** We express our gratitude and thanks to all the participating health care facilities in Barbados.

**Conflicts of Interest:** The authors declare there is no conflict of interest regarding this paper's publication.

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