Knowledge and attitude of family medicine residents toward Personal protective equipment correct usage in king Saud medical city, Riyadh

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Abstract

Background: COVID-19 infection among healthcare workers is a major concern whenever a pandemic occurs. Health care professionals are the frontline in the war against this vicious outbreak which makes them at a higher risk of inquiring the infection than the general population. Use of Personal protective equipment (PPE) is considered a pivotal role in infection control measures. We aimed to study usage of personal protective equipment (PPE) among KSMC family medicine Residents to determine if the appropriate PPE were used by family medicine physician and to examine the factors that may determine inappropriate.

Methodology: This is a cross-sectional study conducted on Family Medicine Residents of KSMC, Riyadh. All levels of residency of family medicine specialty were included in this research. We used convenient non-probability sampling technique.

Results: A total of 134 Family Medicine Residents of KSMC, Riyadh were finally enrolled in this study. 86% of junior and 90% of senior residents received formal training in hand hygiene in the last three years. Most of them know that the main route of cross-transmission of potentially harmful germs between patients is health-care workers’ hands when not clean. Higher percentage of junior cleaning their hands after each consultation compared to senior (98% vs 86% respectively, P = 0.009). There was no statistically significant difference between males and females residents in their knowledge about the main route of cross-transmission of potentially harmful germs between patients (P = 0.006); a higher percentage of males know that the main route is health-care workers’ hands when not clean compared to females (58% vs 52% respectively, P = 0.006), also higher percentage of females using PPE in infection room when a patient confirmed to have Covid-19 when compared to males (97% vs 80% respectively).

Conclusion: At the time of the study, most medical residents were knowledgeable, had a positive attitude, and good level of awareness was observed regarding PPE as it prevents their infection when fighting COVID-19 pandemic. Despite these findings, there were few gaps in resident’s knowledge in certain situations and this need to be addressed through more training courses regarding PPE and this which will significantly raise the level of knowledge and also will set better attitude and practices regarding PPE.

Keywords: protective equipment, attitude of family medicine

Introduction

In December 2019, a new cluster of pneumonia cases were studied and identified as a new virus from the corona family known as the COVID-19 virus. On January, the 30th, 2020 the WHO declared COVID-19 as an international crisis and a cause of concern. Later on March 11, 2020 it was considered as a global pandemic by the WHO [1]. Infection among healthcare workers is a major concern whenever a pandemic occurs. Health care professionals are the frontline in the war against this vicious outbreak which makes them at a higher risk of inquiring the infection than the general population. According to an article from the Lancet, about 30% of Italy’s health care workers died during the COVID-19 pandemic while figures from china have showed that more than 3300 healthcare workers were infected and at least 22 died by the end of March, 2020 [2]. The prevalence of infection among healthcare workers (HCW) 12.5% According to national retrospective study in

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Saudi Arabia [9]. Reasons for infections were addressed in a study in China that revealed that one of the most common reasons was lack of awareness about PPE during the beginning of the Pandemic [9]. As the pandemic continues, PPE proper use and availability is a major concern to protect health care workers from acquiring the Infection and developing subsequent complications.

In addition to administrative and environmental control measures, use of Personal protective equipment (PPE) is considered a pivotal role in infection control measures. Although it is ranked low in the hierarchy of infection control, Transmission based precaution tools used by physicians to prevent the spread of disease between each other and between patients through the use PPE and many health care workers got infected and died during the previous outbreaks such as influenza pandemic (H1N1) in 2009 and Middle East respiratory syndrome coronavirus (MERS-CoV) in 2012 due to the lack of infection control Measures [5, 6, 7, 8].

Going back to literature, we explored prior epidemics and pandemics and different beliefs and attitudes of healthcare professionals towards infection control measures. We found multiple studies. A study done in Bergenheim, UK conducted to evaluate the knowledge, attitudes, experience and behaviour of frontline health care workers in H1N1 breakout. The study revealed that the health care providers were well educated and utilized the provided PPE. About 80% of healthcare workers responded that they wore gloves and surgical masks during the consultation while only 1% reported using eye protection [9].

In 2015, within the era of corona virus, a study evaluated the knowledge, attitudes, and practice of hand hygiene among healthcare professionals in Riyadh, KSA. Overall, the study showed that there was positive behaviours from the health care provider and they committed to hand even under high work stress and there was a significant relationship between higher levels of knowledge and practice of hand hygiene [10]. During the Covid-19 pandemic, in a study that perceived infection control practices and infection transmission routes in a tertiary care hospital in Wuhan found that the main transmission source was not keeping a safe distance while managing infected cases. In terms of using PPE among health care workers, it depended on their presence in high or low risk settings of acquiring the virus. Utilization of masks, gloves and strict hand hygiene was higher in high risk settings [11].

All Family Medicine Residents in KSMC, Levels R1 through R4 worked in the hospital during the pandemic. They worked in high risk settings such as Emergency Medicine, Pediatric Emergency medicine, internal medicine, pediatrics and were doing high risk procedures such as swab collection for suspected Covid-19 patients. This study aims at assessing knowledge, attitude and practice of Family medicine residents toward the use of PPE during the pandemic.

Aims of the study
To assess attitude and knowledge about of Personal Protective Equipment PPE among KSMC Family Medicine Residents.
To compare between different levels of residency training (senior vs junior residents) knowledge and attitudes regarding PPE.

To compare between male and female residents knowledge and attitudes regarding PPE

Methods
This is a cross-sectional study conducted on Family Medicine Residents of KSMC, Riyadh. The residents of this specialty received questionnaire after obtaining their permission to fill it up on I heed learning Panel. All levels of residency were included in this research. The sample size included all 169 residents of family medicine specialty. We used convenient non-probability sampling technique. The questionnaire was distributed after obtaining the IRB approval and validating the questionnaire. The questionnaire contains four sections. First part of the questionnaire about the basic demographics of the participants in addition to weather they were in the front line or not. Second part contains 11 questions about basics about hand hygiene. Third part is about compliance and attitude of the residents towards PPE. Fourth part of the questionnaire assesses knowledge of the residents.

Statistical considerations
This is a cross-sectional study using an online questionnaire built from various studies using permission of the original authors and obtaining IRB approval before distributing the questionnaire. The sample size is 134 as it included all residents of the Family Medicine Academy. The date was entered and analyzed using IBM SPSS® to interpret the results. The data then analyzed using IBM SPSS® to interpret the results. We used P<5. We used statistical tests such as ANOVA test to associate the knowledge score and residency level and t-test to associate gender with knowledge level for comparison.

Ethical considerations
After obtaining the IRB approval, we asked all the Physicians for their permission before handing the questionnaire and the data was private and encrypted in the primary author’s computer with limited access to those working in the research group.

Note
The general rule is that research involving human participants requires a documented (written) informed consent (in Arabic and English). The consent document includes “basic elements” and when applicable “additional elements” (refer to guidelines for consent documents). The IRB may approve a waiver of signed informed consent or a waiver of informed consent. A copy of the consent form was given to the research participant (or surrogate), another copy was kept in the medical record of the patients involved in the research, and the original document was kept with the principal investigator. The signature of at least one parent or guardian, or more, depending on the risk, is required for children under 18 years-of-age to participate in the study. In addition, elementary school age children provide verbal assent (see certification of assent of minors), and middle school age children provide a written assent (co-sign the consent form). A witness signature on the consent form is only needed when the participant or the participant’s guardian cannot read.

Results
A total of 134 Family Medicine Residents of KSMC,
Riyadh were included in this study; most of them were males (53%) and aged 27 years old (28%). Concerning the marital status of the participants; the majority of them were single (58%) while 53 (40%) were married and 3 (2%) were engaged.

59 (44%) of the medical residents were in the second level of residency training and 37 (28%) were in the third level. About their experience, most of them (72%) has more than one and less than 5 years of experience. 128 (96%) of the participants worked in frontline specialty during the pandemic and 115 (86%) were exposed to suspected Covid-19 patients. 52 (39%) of the participants did not conduct nose and throat swabs for any suspected cases they saw while 41 (31%) conducted nose and throat swabs for 10 cases or less. The characteristic of the participants is shown in Table 1.

### Table 1: Baseline characteristic of participants

| Variable                        | Category                                      | N   | %   |
|---------------------------------|-----------------------------------------------|-----|-----|
| Gender                          | Male                                          | 71  | 53  |
|                                 | Female                                        | 63  | 47  |
| Age                             | 25                                            | 14  | 10  |
|                                 | 26                                            | 23  | 17  |
|                                 | 27                                            | 38  | 28  |
|                                 | 28                                            | 15  | 11  |
|                                 | 29                                            | 22  | 16  |
|                                 | 30 and above                                  | 22  | 16  |
| Marital Status                  | Single                                        | 78  | 58  |
|                                 | Married                                       | 53  | 40  |
|                                 | Engaged                                       | 3   | 2   |
| Residency training Level        | 1                                             | 25  | 19  |
|                                 | 2                                             | 59  | 44  |
|                                 | 3                                             | 37  | 28  |
|                                 | 4                                             | 13  | 10  |
| Years of Experience             | less than one year                            | 31  | 23  |
|                                 | More than one and less than 5 years           | 96  | 72  |
|                                 | More than 5 and less than 10 years            | 7   | 5   |
| Exposure to suspected Covid-19 Patients | No                                           | 19  | 14  |
|                                 | Exposed                                       | 115 | 86  |
| worked in frontline specialty during the pandemic: (primary care clinic, ER, ICU, Inpatient medicine wards, Medical quarantine) | No | 6 | 5 |
|                                 | Exposed                                       | 128 | 96  |
| How many suspected cases of covid-19 did you see on whom you conducted nose and throat swabs? Please provide an exact number or a range? | No case                                      | 52  | 39  |
|                                 | 10 and less                                   | 41  | 31  |
|                                 | 11-20                                         | 26  | 19  |
|                                 | 21-30                                         | 4   | 3   |
|                                 | More than 30                                  | 11  | 8   |

Knowledge about hand hygiene practice was compared among senior and junior residents (Table 2), 86% of junior and 90% of senior residents received formal training in hand hygiene in the last three years and there was no significant difference between them (P = 0.471).

### Table 2: Comparing knowledge about hand hygiene practice among senior and junior residents

| Variable                                                                 | Category                                                                 | Junior | Senior | P-value |
|--------------------------------------------------------------------------|--------------------------------------------------------------------------|--------|--------|---------|
| 1. Did you receive formal training in hand hygiene in the last three years? |                                                                         | 12     | 5      | 0.471  |
|                                                                         | No                                                                       | 72     | 45     | 0.063  |
|                                                                         | Health-care workers’ hands when not clean                                | 43     | 31     | 0.544  |
|                                                                         | Air circulating in the clinic                                             | 5      | 8      | 0.544  |
|                                                                         | Patients’ exposure to colonised surfaces (i.e., beds, Chairs, tables, floor) | 23     | 7      | 0.544  |
|                                                                         | Sharing non-invasive objects (i.e., stethoscope, pressure cuffs, etc) between patients | 13     | 5      | 0.544  |
| 2. Which of the following is the main route of cross-transmission of potentially harmful germs between patients in a health-care facility? (Tick one answer only) |                                                                         | 43     | 31     | 0.544  |
|                                                                         | The health Centre’s water system                                          | 6      | 7      | 0.544  |
|                                                                         | The health centre air                                                     | 7      | 8      | 0.544  |
|                                                                         | Germs already present on or within patients                               | 18     | 21     | 0.544  |
|                                                                         | The health centre environment (surfaces)                                  | 53     | 33     | 0.544  |
| 3. What is the most frequent source of germs responsible for healthcare associated infections? (Tick one answer only) |                                                                         | 43     | 31     | 0.544  |
|                                                                         | The health Centre’s water system                                          | 6      | 7      | 0.544  |
|                                                                         | The health centre air                                                     | 7      | 8      | 0.544  |
|                                                                         | Germs already present on or within patients                               | 18     | 21     | 0.544  |
|                                                                         | The health centre environment (surfaces)                                  | 53     | 33     | 0.544  |
| 4. Which of the following hand hygiene actions prevents transmission of germs to the patients |                                                                         | 43     | 31     | 0.544  |
|                                                                         | Before touching a patient                                                 | 82     | 98     | 0.885  |
|                                                                         | Immediately after a risk of body fluid exposure                           | 76     | 91     | 0.765  |
|                                                                         | After exposure to the immediate surroundings of a patient                | 76     | 91     | 0.427  |
|                                                                         | Immediately before a clean/aseptic procedure                             | 82     | 98     | 0.055  |
| 5. Which of the following hand hygiene actions prevents transmission of germs to the health-care workers? |                                                                         | 43     | 31     | 0.544  |
|                                                                         | After touching a patient                                                 | 82     | 98     | 0.285  |
|                                                                         | Immediately after a risk of body fluid exposure                           | 81     | 96     | 0.129  |
|                                                                         | Immediately before a clean/aseptic procedure                             | 71     | 85     | 0.577  |
6. Which of the following statements on alcohol-based hand rub and hand washing with soap and water are true?

| Action | Junior Residents | Senior Residents | P Value |
|--------|------------------|------------------|---------|
| Hand rubbing is more rapid for hand cleaning than hand washing | 85% (82%) | 88% (85%) | 0.002 |
| Hand rubbing causes skin dryness more than hand washing | 50% (45%) | 60% (55%) | 0.021 |
| Hand rubbing is more effective against germs than hand washing | 34% (31%) | 41% (38%) | 0.015 |

7. What is the minimal time needed for alcohol-based hand rub to kill most germs on your hands? (Tick one answer only)

| Time    | Junior Residents | Senior Residents | P Value |
|---------|------------------|------------------|---------|
| 10 seconds | 90% (87%) | 100% (97%) | 0.768 |
| 20 seconds | 76% (73%) | 86% (83%) | 0.641 |
| 50 seconds | 36% (33%) | 55% (52%) | 0.151 |
| 1 minute | 11% (10%) | 19% (18%) | 0.046 |

8. Which type of hand hygiene method is required in the following situations?

| Situation                        | Hand Rubbing | Hand Washing | P Value |
|----------------------------------|--------------|--------------|---------|
| Before palpation of the abdomen   | None         | Rubbing      | 0.021 |
| Before giving an injection        | None         | Washing      | 0.601 |
| After emptying a bedpan           | None         | Rubbing      | 0.684 |
| After removing examination gloves | None         | Washing      | 0.929 |
| After making a patient’s bed      | None         | Rubbing      | 0.705 |
| After visible exposure to blood   | None         | Washing      | 0.571 |

9. Which of the following should be avoided, associated with increased likelihood of colonisation of hands with harmful germs?

| Germs                             | P Value |
|-----------------------------------|---------|
| Damaged skin                      | 0.641   |
| Artificial fingernails            | 0.571   |

10. In the alcohol based hand rub method during the Covid-19 pandemic, the CDC recommends using alcohol based hand rub (ABHR) with 70% ethanol or 60% isopropanol.

| Percentage | P Value |
|-----------|---------|
| 10-20%    | 0.002   |
| 60-70%    | 0.002   |
| 75-90%    | 0.002   |
| 90-100%   | 0.002   |

11. Hands should be washed with soap and water for at least ….. Seconds When visibly soiled before eating or using the toilet.

| Time    | P Value |
|---------|---------|
| 10 seconds | 0.784   |
| 20 seconds | 0.784   |
| 50 seconds | 0.784   |
| 1 minute | 0.784   |

There was also no significant difference between junior and senior residents in their knowledge about the main route of cross-transmission of potentially harmful germs between patients in a health-care facility (P = 0.063); most of them know that the main route is health-care workers’ hands when not clean. 63% of junior residents and 66% of senior residents stated that health centre environment (surfaces) is the most frequent source of germs responsible for healthcare associated infections and the difference between them was not statistically significant (P = 0.544).

There was no significant difference between junior and senior residents in their knowledge about hand hygiene actions that prevents transmission of germs to the patients which includes hand hygiene actions before touching a patient (98% of both of them), immediately after a risk of body fluid exposure (91% vs 92% respectively), after exposure to the immediate surroundings of a patient (91% vs 86% respectively) and immediately before a clean/aseptic procedure (98% vs 90% respectively) as the calculated P values were recorded as 0.885, 0.765, 0.427 and 0.055 respectively.

Also there was no significant difference between junior and senior residents in their knowledge about hand hygiene actions that prevents transmission of germs to the health-care workers which includes hand hygiene actions after touching a patient (98% vs 94% respectively), immediately after a risk of body fluid exposure (96% vs 90% respectively), and immediately before a clean/aseptic procedure (85% vs 88% respectively) and after exposure to the immediate surroundings of a patient (99% vs 100% respectively) as the calculated P values were recorded as 0.285, 0.129, 0.577 and 0.439 respectively.

In a comparison between alcohol-based hand rub and hand washing with soap and water most of junior and senior residents agreed that hand rubbing is more rapid for hand cleaning than hand washing and also most of them agreed that hand rubbing causes skin dryness more than hand washing and both of them are recommended to be performed in sequence, but there no difference between junior and senior residents in their answers about this comparison. 76% of junior and 70% of senior residents know that the minimal time needed for alcohol-based hand rub to kill most germs on your hands is 20 seconds and this difference between them is no statistically significant (P = 0.768).

Concerning the type of hand hygiene method which required in different situations, there were no significant difference between junior and senior residents in their knowledge about hand hygiene method before giving an
injection, after emptying a bedpan, after removing examination gloves, after making a patient’s bed and after visible exposure to blood (P = 0.601, 0.151, 0.684, 0.929 and 0.705 respectively), while a significant difference was found between them in the hand hygiene method required before palpation of the abdomen (P = 0.021); a higher percentage of junior select rubbing compared to senior (79% vs 60% respectively).

There was no significant difference between junior and senior residents in their knowledge about the things that should be avoided, as associated with increased likelihood of colonization of hands with harmful germs which include wearing jewellery (P = 0.471), damaged skin (P = 0.641), artificial fingernails (P = 0.571), regular use of a hand cream (P = 0.316). In contrary, a significant difference was found between junior and senior residents in their knowledge about the concentration of ethanol and isopropanol which recommended by CDC when using alcohol based hand rub (P = 0.002); a higher percentage of senior selected 60-70% compared to junior (66% vs 32% respectively) and most of the junior (36%) selected the concentration of 75%-90%. There was no significant difference between junior and senior residents in their knowledge about the duration of hands washing when using soap and water when visibly soiled before eating or using the toilet (P = 0.784); most of them stated that the duration of hand washing is 20 seconds. Attitude toward usage of PPE was compared among senior and junior residents (Table 3). There was no statistically significant difference between junior and senior residents about wearing surgical masks by suspected patients whilst in common areas or throughout the consultation (P = 0.366, 0.946 respectively). Also there was no statistically significant difference between junior and senior residents in wearing surgical mask, gloves or Apron/ Gown whilst they in close contact (within 2 meters) with suspected cases. In contrary higher percentage of junior use eye protection compared to senior (67% vs 46% respectively) and the difference was statistically significant (P = 0.019). There was no significant difference between junior and senior residents in cleaning their hands before each consultation (P = 0.341) while higher percentage of junior cleaning their hands after each consultation compared to senior (98% vs 86% respectively) and the difference was statistically significant (P = 0.009). Also there was no statistically significant difference between junior and senior residents in their confidence about their knowledge around infection control procedures when consulting a suspected case of Covid-19 (P = 0.261); most of junior (54%) and senior (62%) were somewhat confident. When comparing knowledge about correct usage of PPE in different situations among junior and senior residents (Table 4); no significant difference was found between them in knowledge about correct usage of PPE in infection room when a patient confirmed to have Covid-19 (P = 0.528). We found that 88% of both of them use medical mask, gown, gloves and eye protection (goggles or face shield).

Table 3: Comparing attitude toward usage of PPE among senior and junior residents

| Variable | Category | Junior | Senior | P-value |
|----------|----------|--------|--------|---------|
| Did patients who were suspected cases wear surgical masks | Whilst in common areas | 73 87 46 92 | 0.366 |
| Throughout the consultation | 77 92 46 92 | 0.946 |
| Did you wear the following whilst in close contact (within 2 meters) with suspected cases? | Surgical mask | 82 98 49 98 | 0.885 |
| | Gloves | 73 87 38 76 | 0.105 |
| | Apron/Gown | 69 82 37 74 | 0.262 |
| Did you clean your hands (with either alcohol gel or soap and water) | Eye protection 10 | 56 67 23 46 | 0.019 |
| before each consultation | 71 85 39 78 | 0.341 |
| after each consultation | 82 98 43 86 | 0.009 |
| How confident do you feel about your knowledge around infection control procedures when consulting a suspected case of Covid-19? | Not confident at all | 0 0 2 4 | 0.261 |
| | Not very confident | 9 11 4 8 |
| | Somewhat confident | 45 54 31 62 |
| | Very confident | 29 35 12 24 |
| | Extremely confident | 1 1 1 2 |

Table 4: Comparing knowledge about correct usage of PPE in different situations among senior and junior residents

| Variable | Category | Junior | Senior | P-value |
|----------|----------|--------|--------|---------|
| Inpatient settings: 1. In a patient confirmed to have Covid-19 infection room: | Medical mask, Gown, Gloves, Eye protection (goggles or face shield) | 74 88 44 88 | 0.528 |
| | Medical mask, Gown, Gloves | 7 8 6 12 |
| | Medical mask, Gloves | 2 2 0 0 |
| | No PPE required | 1 1 0 0 |
| Inpatient settings: 2. While providing care for a Covid-19 patient and doing Aerosol-generating procedures: | Respirator N95 or FFP2 standard, or equivalent. Gown Gloves Eye protection Apron | 72 86 40 80 | 0.532 |
| | Medical mask, Gown, Gloves, Eye protection (goggles or face shield) | 8 10 8 16 |
| | Medical mask, gloves, gloves | 4 5 2 4 |
| | No PPE required | 0 0 0 0 |
| 3. In outpatient facilities, in consultation rooms while examining a patient with respiratory symptoms: | Medical mask, Gown, Gloves, Eye protection (goggles or face shield) | 52 62 32 64 | 0.94 |
| | Medical mask, Gown, Gloves | 22 26 13 26 |
| | Medical mask, Gloves | 10 12 5 10 |
| | No PPE required | 0 0 0 0 |
| 4. In outpatient facilities, in consultation rooms while examining a patient without respiratory symptoms: | Medical mask, Gown, Gloves, Eye protection (goggles or face shield) | 24 29 13 26 | 0.112 |
| | Medical mask, Gown, Gloves | 22 26 13 26 |
| | PPE according to standard precautions and risk assessment | 27 32 23 46 |
There was also no significant difference between junior and senior in knowledge about correct usage of PPE while providing care for a Covid-19 patient and doing Aerosol-generating procedures (P = 0.532); most of junior and senior (86% and 80% respectively) know that they must use respirator N95/FFP2 standard, or equivalent and gown, gloves, eye protection and apron. Also there were no significant differences between junior and senior in knowledge about correct usage of PPE in outpatient facilities in consultation rooms while examining a patient with or without (P = 0.94, 0.112 respectively) respiratory symptoms; a higher percentage of both of them using all PPE when examine examining a patient with respiratory symptoms comparing to patient without respiratory symptoms.

There was also no significant difference between junior and senior in knowledge about correct usage of PPE in Ambulance or transfer vehicles, while transferring covid-19 patients to the referral health care facility (P = 0.727); 64% of junior and 70% of senior use medical mask, gown, gloves and eye protection (goggles or face shield). Knowledge about hand hygiene practice was compared among males and females residents (Table 5), 87% of both of males and females residents received formal training in hand hygiene in the last three years and there was no significant difference between them (P = 0.997).

### Table 5: Comparing knowledge about hand hygiene practice among male and female residents

| Variable | Category | Male | Female | P-value |
|----------|----------|------|--------|---------|
| 1. Did you receive formal training in hand hygiene in the last three years? | No | 9 | 13 | 0.997 |
| | Yes | 62 | 87 |
| 2. Which of the following is the main route of cross-transmission of potentially harmful germs between patients in a health-care facility? (Tick one answer only) | Health-care workers’ hands when not clean | 41 | 56 | 0.006 |
| | Air circulating in the clinic | 11 | 16 | |
| | Patients’ exposure to colonised surfaces (i.e., beds, Chairs, tables, floor) | 15 | 21 | |
| | Sharing non-invasive objects (i.e., stethoscope, pressure cuffs, etc) between patients | 4 | 6 | |
| 3. What is the most frequent source of germs responsible for health-care associated infections? (Tick one answer only) | The health centre’s water system | 6 | 9 | 0.344 |
| | The health centre air | 5 | 7 | |
| | Germs already present on or within the 13 patients | 5 | 21 | |
| | The health centre environment (surfaces) | 45 | 63 | |
| 4. Which of the following hand hygiene actions prevents transmission of germs to the patients | Before touching a patient | 70 | 99 | 0.49 |
| | Immediately after a risk of body fluid exposure | 65 | 92 | 0.828 |
| | After exposure to the immediate surroundings of a patient | 62 | 87 | 0.564 |
| | Immediately before a clean/aseptic procedure | 68 | 96 | 0.581 |
| 5. Which of the following hand hygiene actions prevents transmission of germs to the health-care workers? | After touching a patient | 69 | 97 | 0.553 |
| | Immediately after a risk of body fluid exposure | 65 | 92 | 0.198 |
| | Immediately before a clean/aseptic procedure | 69 | 97 | 0.973 |
| 6. Which of the following statements on alcohol-based hand rub and hand washing with soap and water are true? | Hand rubbing is more rapid for hand cleaning than hand washing | 50 | 67 | 0.008 |
| | Hand rubbing causes skin dryness more than hand washing | 51 | 69 | |
| | Hand rubbing is more effective against germs than hand washing | 39 | 54 | |
| | Hand washing and hand rubbing are recommended to be performed in sequence | 36 | 51 | |
| 7. What is the minimal time needed for alcohol-based hand rub to kill most germs on your hands? (Tick one answer only) | 10 seconds | 12 | 16 | 0.284 |
| | 20 seconds | 55 | 74 | |
| | 50 seconds | 11 | 11 | |
| | 1 minute | 4 | 6 | |
| 8. Which type of hand hygiene method is required in the following situations? | Before palpation of the abdomen | None | 0 | 0 | 0.74 |
| | Rubbing | 50 | 70 | |
| | Washing | 21 | 30 | |
| | Before giving an injection | None | 4 | 6 | 0.16 |
| | Rubbing | 36 | 51 | |
| | Washing | 31 | 44 | |
| | After emptying a bedpan | None | 4 | 6 | |
| | Rubbing | 23 | 32 | |
| | Washing | 44 | 62 | |
| | After removing examination gloves | None | 0 | 0 | 0.456 |
| | Rubbing | 35 | 49 | |
| | Washing | 36 | 51 | |
| | After making a patient’s bed | None | 1 | 1 | 0.563 |
There was a significant difference between males and females residents in their knowledge about the main route of cross-transmission of potentially harmful germs between patients in a health-care facility (P = 0.006); a higher percentage of males know that the main route is health-care workers’ hands when not clean compared to females (58% vs 52% respectively). 63% of males residents and 65% of females residents stated that health centre environment (surfaces) is the most frequent source of germs responsible for health-care associated infections and the difference between them was not statistically significant (P = 0.344).

There was no significant difference between males and females residents in their knowledge about hand hygiene actions that prevents transmission of germs to the patients which includes hand hygiene actions before touching a patient (99% vs 97% respectively), immediately after a risk of body fluid exposure (92% vs 91% respectively), after exposure to the immediate surroundings of a patient (87% vs 91% respectively) and immediately before a clean/aseptic procedure (96% vs 94% respectively) as the calculated P values were recorded as 0.49, 0.828, 0.564 and 0.0581 respectively.

Also there was no significant difference between males and females residents in their knowledge about hand hygiene actions that prevents transmission of germs to the health-care workers which includes hand hygiene actions after touching a patient (97% vs 95% respectively), immediately after a risk of body fluid exposure (92% vs 97% respectively), and immediately before a clean/aseptic procedure (86% of both of them) and after exposure to the immediate surroundings of a patient (100% vs 98% respectively) as the calculated P values were recorded as 0.553, 0.198, 0.973 and 0.287 respectively. In a comparison between alcohol-based hand rub and hand washing with soap and water and there was no significant difference between 12 males and females in their answers. Most of males and females residents agreed that hand rubbing is more rapid for hand cleaning than hand washing (83%, 73% respectively) and also most of them agreed that hand rubbing causes skin dryness more than hand washing (76%, 68% respectively), but there was significant difference between them about that hand washing and hand rubbing are recommended to be performed in sequence compared to males (73% vs 51% respectively). 78% of males and 70% of females residents know that the minimal time needed for alcohol-based hand rub to kill most germs on your hands is 20 seconds and this difference between them is no statistically significant (P = 0.284). Concerning the type of hand hygiene method which required in different situations, there were no significant difference between males and females residents in their knowledge about hand hygiene method before palpation of the abdomen, before giving an injection, after emptying a bedpan, after removing examination gloves, after making a patient’s bed and after visible exposure to blood (P = 0.74, 0.16, 0.054, 0.456, 0.563 and 0.928 respectively). There was no significant difference between males and females residents in their knowledge about the things that should be avoided, as associated with increased likelihood of colonization of hands with harmful germs which include wearing jewellery (P = 0.12), damaged skin (P = 0.338), artificial fingernails (P = 0.06) and regular use of a hand cream (P = 0.8). Also there was no significant difference between males and females residents in their knowledge about the concentration of ethanol and isopropanol which recommended by CDC when using alcohol based hand rub (P = 0.076). There was no significant difference between males and females residents in their knowledge about the duration of hands washing when using soap and water when visibly soiled before eating or using the toilet (P = 0.158); most of them stated that the duration of hand washing is 20 seconds. Attitude toward usage of PPE was compared among males and females residents (Table 6). There was no statistically significant difference between males and females residents about wearing surgical masks by suspected patients whilst in common areas or throughout the consultation (P = 0.285, 0.075 respectively). Also there was no statistically significant difference between males and females residents in wearing surgical mask, gloves, Apron/ Gown or eye protection whilst they in close contact (within 2 meters) with suspected cases (P = 0.099, 0.405, 0.227, 0.315 respectively). Also there was no significant difference between females and males residents in cleaning their hands after each consultation (P = 0.395) while higher percentage of females cleaning their hands after each consultation compared to males (91% vs 75% respectively) and the difference was statistically significant (P = 0.017). Also there was no statistically significant difference between males and females residents in their confidence about their knowledge around infection control procedures when consulting a suspected case of Covid-19 (P = 0.472); most of males (61%) and females (52%) were somewhat confident.
There was no significant difference between males and females in knowledge about correct usage of PPE while providing care for a Covid-19 patient and doing Aerosol-generating procedures: (P = 0.602); most of male and females (85%, 83% respectively) use respirator N95/FFP2 standard, or equivalent and gown, gloves, eye protection and apron. Also there were no significant differences between males and females in knowledge about correct usage of PPE in outpatient facilities in consultation rooms while examining a patient with or without respiratory symptoms; a higher percentage of both of them using PPE when examine examining a patient with respiratory symptoms comparing to patient without respiratory symptoms.

There was also no significant difference between males and females in knowledge about correct usage of PPE in Ambulance or transfer vehicles, while transferring covid-19 patients to the referral health care facility (P = 0.25); 72% of males and 60% of females use medical mask, gown, gloves and eye protection (goggles or face shield).

**Discussion**

Medical resident’s level of knowledge and awareness towards personal protective equipment has crucial role during COVID-19 pandemic as it is considered one of the most important determinants of safety for both medical residents and other healthcare workers fighting the pandemic.

The main aim of this study was to assess knowledge and attitude about of Personal Protective Equipment PPE among KSMC Family Medicine Residents. Also to compare between different levels of residency training (senior versus junior residents) knowledge and attitudes regarding PPE and to compare between male and female residents knowledge and attitudes regarding PPE.

In the current study most of respondents were males and females in knowledge about correct usage of PPE in infection room...
within the age group of less than thirty years old. Regarding the marital status of the respondents; about two thirds of them were single. Nearly half of the medical residents were in the second level of residency training and one third of them were in the third level. The vast majority of them worked in frontline specialty during the pandemic and most of them were exposed to suspected Covid-19 patients. Regarding the general knowledge level senior residents were found to be more knowledgeable than junior residents but the knowledge gap between them was not wide in most aspects of comparison. Regarding knowledge about hand hygiene practice among senior and junior residents 86% of junior and 90% of senior residents received formal training in hand hygiene in the last three years and these percentages are considered to be high when compared to other study which conducted in Egypt showing only 60% of residents willing to have or had training regarding hand washing practice [12]. In a comparison between rub hands washing with soap and water and alcohol-based hand most of junior and senior residents agreed that hand rubbing is quicker for hand cleaning than hand washing and also most of them agreed on that hand rubbing causes skin dryness more than hand washing and both of them are recommended to be performed in sequence also alcohol-based hand washing preference among healthcare workers during COVID-19 pandemic was found in other study in India [13]. Concerning knowledge about alcohol concentration in alcohol-based hand washing solutions; higher percentage of senior selected 60-70% alcohol concentration compared to junior and most of the junior residents selected the concentration of 75%-90%. Higher concentrations of alcohol in alcohol based hand sanitizers are highly recommended as it will increase the effectiveness of its mechanism of action which is mainly through dissolving the lipid membranes of microbes and the recommended concentrations are better to be between 70-90% as demonstrated by other study which conducted in Malaysia [14]. About 63% of junior residents and 66% of senior residents stated that health center environment or surfaces is the most frequent source of germs responsible for health-care associated infections and this mostly due to shedding of infectious microbes from infected person on other surfaces like glass, copper and plastic and the amount of surface contamination is significantly associated with microbial load within the infected patient the same finding was found in other study which conducted by John D. CoPPEn et al. in USA [15]. In this study we found that higher percentage of female residents using PPE when compared to males and this finding was also found in other parallel study which conducted in Poland showing females with much higher adherence to PPE and hand washing practices [16]. Higher percentage of both of them using PPE when examine examining a patient with respiratory symptoms comparing to patient without respiratory symptoms but this behavior should be changed to constant usage of PPE when examining patients with or without respiratory symptoms as demonstrated in other study which conducted in Australia which stated that usage of PPE should be for any symptoms as COVID-19 symptoms may evolve or change also patient with other complain may have a symptomatic infection [17]. Attitude toward usage of PPE was compared among senior and junior residents. There was no statistically significant difference between junior and senior residents about wearing surgical masks by suspected patients whilst in common areas or throughout the consultation and this was in contradiction to other study which conducted in India showing significant association between junior residents and senior residents and their practices regarding the use of PPE [13]. There was no significant difference between junior and senior residents in cleaning their hands before each consultation, while higher percentage of juniors cleaning their hands after each consultation compared to seniors. Regarding knowledge and attitude association or difference between male and female residents; there was significant difference between them about that hand washing and hand rubbing are recommended to be performed in sequence with higher percentage of females agreed on that hand washing and hand rubbing are recommended to be performed in sequence compared to males. There is no statistically significant difference between males and females residents about wearing surgical masks by suspected patients whilst in common areas or throughout the consultation. There was a significant difference between males and females residents in their knowledge about the main route of cross-transmission of potentially harmful germs between patients in a health-care facility and similar finding was found in parallel study which conducted by Abdurrahman et al. in Saudi Arabia [18]. There was significant association between them in regards to knowledge about correct usage of PPE in infection room when a patient confirmed to have Covid-19 with females having higher percentage of using PPE when compared to males. No significant difference between males and females regarding knowledge about correct usage of PPE in Ambulance or transfer vehicles, while transferring covid-19 patients to the referral health care facility.

Conclusion

At the time of the study, most medical residents were knowledgeable, had a positive attitude, and good level of awareness was observed regarding PPE as it prevent their infection when they are fighting COVID-19 pandemic. Despite these findings, there was few gaps in resident’s knowledge in certain situations and this need to be addressed through more training courses regarding PPE and this which will significantly raise the level of knowledge and also will set better attitude and practices regarding PPE.

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