Deanship of Graduate Studies

Al-Quds University

The Impact of COVID-19 Pandemic on Medical Imaging Workers: Infection Sources, Awareness and Commitment to relevant Safety Guidelines

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Dedication

I dedicate my thesis to my loving parents, sisters, and brothers for their prayers and inspiration. I also dedicate this work to my wife and kids, whom have been so supportive, encouraging, and patient during this project.

I dedicate this effort and express my gratitude to my close friends and colleagues who have faith in my capabilities.

Abdulkarim Dahdolan

Declaration

I hereby declare that the work presented in this thesis, titled "The Impact of COVID-19 Pandemic on Medical Imaging Workers: Infection Sources, Awareness, and Commitment to Relevant Safety Guidelines," was done by me under the supervision of Dr. Mohammad Hjouj in partial fulfillment of the requirements for the award of the degree of Master in Medical Imaging Technology from Al-Quds University.

This thesis' content has not been submitted to any other university or institution for the award of any other degree.

Signed 

Abdulkarim Khalil Atallah Dahdolan

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Abstract

Introduction: COVID-19 virus disease is an infectious disease caused by SARS-Cov-2 virus, that was first reported in China, in December, 2019. Most infected patients with COVID-19 have mild to moderate symptoms and recover without treatment but symptoms may worsen in some cases, requiring hospital treatment. As the diagnostic imaging department play a remarkable role in detecting and diagnosing of COVID-19 in early stages, therefore, medical imaging workers (MIWs) should be aware of infection control and prevention (ICP) measures to prevent the transmission of the disease. **Objectives:** this study aimed to evaluate the impact of COVID-19 pandemic on MIWs; in terms of infection sources, awareness and commitment to relevant safety guidelines. **Methods:** a cross-sectional descriptive study design was conducted from July 15, 2021 to September 15, 2021, in diagnostic imaging departments in Palestinian health care system, using a questionnaire distributed personally, the inclusion criteria were all MIWs in Main Palestinian hospitals were on duty during the COVID-19 pandemic to assess source of infection among MIWs and to assess knowledge, awareness regarding ICP guidelines. **Results:** from a 205 valid responses, there was 54.5% governmental, 27.2% private, and 18.3% from NGOs sector. Female were 26.8% and 81.9% holding bachelor degree, about 41.2% are less than five years of experience. 36.1% had a previous positive COVID-19 result, of them there was 61.6% due to nosocomial infection. Only 63.2% were confidence of their hospital preparedness for COVID-19, 65.1% felt that their department is capable of dealing with COVID-19 patients, 43.3% revealed that they had training on handling COVID-19 patients, 58.7% reported that self-reading was their source of information about COVID-19, inadequate training or knowledge about hand hygiene and proper use of personnel protective equipment (PPE) was noted. **Conclusion:** As a result, our findings emphasize the vital need of expanded COVID-19 pandemic training for MIWs, as well as related protective measures. In a related context, we recommend that all faculties that graduate medical imaging students should provide an infection control and prevention course and make it a mandatory for medical imaging students.

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Chapter 1: Introduction

1.1.Background and Significance

Corona virus disease (COVID-19) is an infectious disease caused by the Severe Acute Respiratory Coronavirus 2 (SARS-Cov-2) that was first discovered in December, 2019, in Wuhan, China. In March, 2020 World Health Organization (WHO) declared COVID-19 as a global pandemic (WHO, 2021). There had been 226,844,344 confirmed cases and 4,666,334 deaths worldwide (WHO, 2021) as of the day began writing this thesis.

Corona viruses have been linked to the Severe Acute Respiratory Syndrome (SARS) outbreak in 2003 (WHO, 2003), the Middle East Respiratory Syndrome (MERS) outbreak in 2013 (Groot, et al., 2013), and the current COVID-19 pandemic.

SARS-CoV-2 viruses have a diameter of 60 - 140 nm and prominent spikes ranging from 9 – 12 nm, giving them the appearance of a solar corona. Corona viruses are single-stranded Ribonucleic Acid (RNA) viruses that infect humans and other mammals e.g. dogs, cats, pigs and birds, and can cause respiratory, gastrointestinal and neurological problems (wiersinga, Rhodes, Cheng, Peacock, & Prescott, 2020).

And like many other RNA viruses, has evolved into new variants as transmission progresses and can adapt to and infect new hosts through genetic recombination and variation (Goldsmith, et al., 2004).

These variants have been classified as Variants of Concern (VOC) or Variant of Interest (VOI) based on their transmissibility, disease severity (e.g. increased hospitalizations or deaths), and the extent of reduction in neutralization by antibodies generated during previous infection or vaccination, reduced effectiveness of treatments, or diagnostic detection failures (CDC, 2021). There are eleven known variants of SARS-CoV-2 (alpha, Beta, Gamma, Delta, Delta Plus, Epsilon, Eta, Theta, Iota, Kappa, and Lambda) and this list is likely to grow as new variants emerge (CDC, 2021).

Although bats are assumed to be a natural reservoir for SARS-CoV-2, it is possible that humans contracted the virus through an intermediary host, such as the pangolin (Lu, et al., 2020; Lam, et al., 2020).

Transmission of COVID-19 virus occurs primarily via respiratory droplets (Ganyan, et al., 2020), can spread from an infected person in small liquid particles when he/she cough, sneeze, speak, sing or breathe. So the most people are in risk of virus transmission those who are in close contact (within 1 meter), or those whom sitting for long time in poorly ventilated and/or crowded

indoor settings, when droplets containing the virus are inhaled or come directly in contact with eyes, nose or mouth (wiersinga et al., 2020; WHO, 2021). Another route of transmission is contact surface spread (touching a virus-infected surface) (wiersinga et al., 2020). Aerosol (smaller droplets) transmission is also possible, but the role of this transmission is still unclear related to humans (Ganyan, et al., 2020).

COVID-19 pandemic has resulted in an unexpected high number of hospitalization for pneumonia with multi organ disease. SARS-CoV-2 infection can be asymptomatic or induce a wide range of symptoms, including upper respiratory infection symptoms and life threating sepsis (wiersinga et al., 2020).

About 80% of those, whom get infected with COVID-19, recover without needing hospital treatment. And about 15% become seriously ill and need oxygen, while those whom need intensive care because of their critical illness and complications are about 5% (WHO, 2021).

The Most common symptoms that the affected patient with COVID-19 will develop are fever (70% - 90%), dry cough (60% - 86%) and general fatigue (38%), and the less common symptoms include loss of tasty or smell, nasal congestion, sore throat, headache, weakness (25%) myalgia (15% - 44%), nausea/vomiting or diarrhea (15% - 39%), and chills or dizziness[1]. Severe infected cases of COVID-19 will develop symptoms like shortness of breath SOB, loss of appetite, confusion, pressure in the chest and high temperature (> 38 $^{\circ}$C) (WHO, 2021; Mao, et al., 2020).

However, anyone can get COVID-19 and become seriously ill and die at any age, but people at higher risk of developing serious illness are more than 60 years old, people having medical problems e.g. high blood pressure heart and lung diseases, diabetes, obesity or cancer (WHO, 2021).

COVID-19 has a 5 (2-7) days incubation period (the time between exposure to virus and the beginning of symptoms), approximately 97.5% of those who are sick have symptoms within 11.5 days after getting sick (Lauer, et al., 2020; Guan, et al., 2020). The median time between the beginning of symptoms and admission to the hospital is 7 (3-9) days (Garg, et al., 2020). The average age of hospitalized patients ranges from 47 – 73 years old. 74 % - 86% of COVID-19 patients admitted to hospitals are over the age of 50 (Garg, et al., 2020; Richardson, et al., 2020; Docherty, et al., 2020).

Reverse Transcription Polymerase Chain Reaction (RT-PCR) molecular test is the most commonly test used to detect COVID-19 infection, by collecting samples from nose and/or throat. This molecular test makes an amplifying for the virus to detectable level (WHO, 2021). While this is the molecular test used to confirm an active infection of COVID-19 but it suffers

from low sensitivity (e.g. 60% - 70%) in the early detection of COVID-19, due to the false negative rate and the long time it takes to get the result with respect to the need for rapid decision-making for patients with clinically noticeable pneumonia (Ai, et al., 2020; Fang, et al., 2020; Li, et al., 2020; Yang, et al., 2020; Diao et al., 2020).

The appropriateness of the specimen collecting technique, time from exposure and specimen source are all factors that contribute to false-negative test findings. Bronchoalveolar lavage fluid and other lower respiratory samples are more sensitive than upper respiratory samples. Bronchoalveolar lavage fluid specimen had the highest positive rates of SARS-CoV-2 PCR testing results (93%) among 1070 specimens collected from 205 patients with COVID-19 in China, followed by sputum (72%), nasal swabs (63%) and pharyngeal swabs (32%). SARS-CoV-2 can be found in feces as well, but not in urine. Also, saliva could be an alternative specimen sources but requires further validation (Wang, et al., 2020; Williams et al., 2020).

Another test used to detect COVID-19 virus is rapid antigen test or what is sometimes called as a Direct Antigen Rapid Tests (DARTs), this test is cheaper than PCR and more quickly but it is suffer from less accuracy (WHO, 2021).

Harmon et al, showed that twice-weekly surveillance with DARTs detected infection in 15 people with 96.2% sensitivity on day 0 through day3 of symptoms in a cohort trial of 257 people who collected 2951 sample pairs over 6 months (Harmon, et al., 2021). If 75% of population is monitored, detection on day 3 is almost as efficient as detection on day 1 in reducing the occurrence of COVID-19 (Larremoure, et al., 2021). The frequency of testing and its efficiency in limiting possible outbreaks are determined by the disease prevalence, for Harmon et al study the COVID-19 prevalence was between 1% and 8% of the participants (Harmon, et al., 2021).

The co-working facilities' operations were able to continue safely during the pandemic due to the use of twice-weekly DART testing, also infected people can be discovered and quarantined quickly due to frequent at-home DARTs and in-person work environments and other social settings can be protected by such surveillance (Harmon, et al., 2021).

Diagnostic imaging examination, mainly high resolution chest computed tomography (HRCT) and chest x-ray (CXR) play a remarkable role in detecting coronavirus disease, chest CT is preferred over CXR because of its accuracy, improved contrast resolution, high sensitivity and ability to pick the disease in the initial phase (Diao et al., 2020; Shazeb, Khan, & Muhammad, 2020; Shi, et al., 2020; Zu, et al., 2020). In detecting pulmonary abnormalities, HRCT is more sensitive than CXR (Ng, et al., 2020).

Multifocal bilateral Ground Glass Opacities (GGOs) with patchy consolidations, prominent peripherally sub pleural distribution and posterior part or lower lobe predilection are typical CT features of COVID-19 pneumonia (Zu, et al., 2020; Ng, et al., 2020). GGOs found on HRCT are frequently missed on CXR. Given that GGOs are still the most common manifestation of SARS-CoV-2 pneumonia, so HRCT should be the first choice imaging modality for detecting pulmonary abnormalities (Diao et al., 2020). Early in the disease, CT scan imaging findings in

around 15% of patients and CXR results in about 40% of patients can be normal (Guan, et al., 2020).

Person-to-person transmission in family homes or hospitals, as well as intercity spread of this novel coronavirus, and thus alert control measures are warranted at early stage of the pandemic (Chan, et al., 2020). Since the beginning of COVID-19 pandemic healthcare workers (HCWs) were worried more than other people about their risk of COVID-19 infection, due to their professional and moral duty toward the infected patients in all over the world, which puts them in close contact with infected patients during examinations and their contaminated environments (Xiao et al., 2020).

In 2020 researcher in China reported 3,387 infections among HCWs (4.4% of all cases) (Zhan, Qin, Xue, & Zhu, 2020). The Italian National Institute of Health also reported that 17,000 HCWs have been infected (about 10% of all cases) (EpiCentro, 2020), and the US Centers of Disease Control and Prevention (CDC) reported the more than 9,200 HCWs were diagnosed with COVID-19 in the US between February 12 and April 9, 2020 (CDC, 2020).

During the peak of COVID-19 pandemic in Italy, HCWs were frequently infected due to close contact with other positive cases among HCWs and patients. Because of the majority of reported symptoms were mild and non-specific, symptom-centered prevention strategies didn't provide adequate protection. Due to lower protection protocols; departments other than those treating COVID-19 patients may be a high-risk setting (Mandić-Rajčević, et al., 2020).

In Milan, Italy, also a study noted that 29.3% of the infections were from colleagues, thus also requiring special attention for social distances and infection control measures between HCWs (Oksanen, et al., 2021).

Also, Medical Imaging Workers (MIWs) are expected to be at a higher risk of being infected with COVID-19, due to the role of diagnostic imaging departments which puts MIWs team in the frontline facing this new pandemic (CDC, 2020). Not far away, during the pandemic of MERS in Saudi Arabia, it was reported that (MIT) had the highest infection rate in hospital units in Jeddah, where infected patients were treated (Alraddadi, et al., 2016). Lack of infection control knowledge and direct contact with infected patients were the main reasons of high rate of infectious among MIT during the pandemic of MERS in Saudi Arabia (Alraddadi, et al., 2016; Omrani & Shalhoub, 2015).

1.2.Problem Statement

As the diagnostic imaging departments have a main role in detecting and diagnosing of COVID-19 in early stages (Shazeb et al., 2020; Shi, et al., 2020), therefore, MIWs should be aware of infection control measures and trained in the use of personnel protective equipment's (PPE) to prevent the transmission of disease (Omrani & Shalhoub, 2015).

According to the Palestinian Ministry of Health, until 25 September 2021 there is 426035 total infected cases and 4286 deaths in Palestine. Between the total of infected cases there is 6116 infected HCWs (1.53%) (Ministry of Health, 2021). The total number of infected MIT in Palestine was 85 MITs; 65 in governmental sector and 20 MITs in private sector, according to Palestinian Association of Medical Radiographic Technologists (PAMRT).

Palestinian MIWs should be aware of the recommended infection control and prevention (ICP) techniques, e.g. frequent hand washing, social distancing, and the way to use PPE. There is a serious need to examine their preparedness and awareness for this massive pandemic to ensure their safety and cover the expanding clinical needs.

In general, HCW safety is critical not only to preserve employee's health and well-being, but also to prevent the spread of infection among patients and other HCWs, which could result in staffing shortage during this acute public health crisis (Mandić-Rajčević, et al., 2020; Sabetian, et al., 2021).

Previous pandemics of a similar SARS condition have taken a heavy toll on health-care workers. WHO documented 8098 cases and 774 (9.6%) deaths during the SARS pandemic 2002, with HCWs accounting for 1707 (21%) of the cases. In addition, Singapore revealed that health care personnel; accounted for 41% of the 238 suspected SARS cases (Hsu, et al., 2003).

The above mentioned study where held in Milan, Italy, researchers aimed to describe and analysis the sources, symptoms and duration of SARS-CoV-2 infection in a large public healthcare organization in Milan during the most severe weeks of the pandemic. They were facing a difficulty in determining the true source of infection in HCWs. Nonetheless, their hypothesis is supported by the high percent positive incidence of more than 10% among tested close acquaintances compared to 2% among randomly tested individuals (Mandić-Rajčević, et al., 2020).

1.3.Literature review

It is critical to diagnose COVID-19 early in order to treat and control the disease. In comparison to RT-PCR, chest CT may be more reliable, practical and quick method of diagnosing and assessing COVID-19, particularly in pandemic area (Ai, et al., 2020).

Ai et al from China, conduct a retrospective study on 1014 patients to make a comparison between RT-PCR and Chest CT, the sensitivity, specificity and accuracy of chest CT in detecting COVID-19 infection were 97% (580 of 601 Pts.), 25% (105 of 413 Pts.) and 68% (685 of 1014 Pts.), respectively, using RT-PCR data as the reference standard (Ai, et al., 2020).

Guan et al in their study revealed that the sensitivity of chest CT in detecting COVID-19 was 86.2% (Guan, et al., 2020), while Ai et al found that chest CT sensitivity is 97% (Ai, et al., 2020), and Fang et al' study found that the sensitivity of chest CT were 98% versus 71% the sensitivity of RT-PCR (Fang, et al., 2020).

A retrospective study on 610 hospitalized patients clinically diagnosed with COVID-19 was held at Hankou Hospital in Wuhan to describe the stability issues of RT-PCR testing of SARS-CoV-2. The researchers concluded that RT-PCR test results of pharyngeal swab specimen were variable and potentially unstable, and they shouldn't be used as the only indicator for diagnosis, treatment, isolation, and recover (Li, et al., 2020).

As mentioned in the background and significance section that the COVID-19 virus is transmitted mainly via droplets or aerosol particles evicted out from infected persons during coughing, sneezing, talking ...etc. Thus, standard precautions e.g. social distancing, hand hygiene and wearing masks were considered as an effective manner to prevent the virus transmission (Alharbi & Mandoura, 2021).

Preventing infections among HCWs is important for reducing morbidity and potential mortality, keeping the healthcare system running, and reducing secondary transmission, so HCWs have the priority for testing throughout the pandemic (Chou, et al., 2020; Adams & Walls, 2020; Perlis, 2020). For HCWs, the COVID-19 pandemic has been linked to significant stress and adverse mental health effects (Cheng, et al., 2020)

Chou et al. found that coronavirus infections, such as SARS-CoV-2, have a severe impact on HCWs in their retrospective cohort assessment of 64 published research on the burden of coronaviruses on HCWs. Specific exposures are connected to a higher risk of infection, while PPE and infection control training are linked to a lower risk of infection. (Chou, et al., 2020).

COVID-19 transmission from HCWs to patients and household contacts is a possibility (Schwartz, et al., 2020). Particularly since it has been discovered that presymptomatic cases account for a significant number of transmissions (Cheng, et al., 2020). Transmission of infection to family members has been a cause of anxiety for HCWs (Lai, et al., 2020).

Commitments to infection control standard precautions from HCWs, may prevent a percentage of the risk of acquiring occupational infections from known or unknown sources in healthcare institutions (Siegel et al., 2007; Phillips & Ker, 2006).

A cross-sectional study was done to evaluate the knowledge of healthcare students after four curricula on infection control and to identify sources of information, by a questionnaire that cover three areas; standard precautions, hand hygiene and nosocomial infection. The study targeted nursing students, physiotherapist students, medical students and assistant radiologists. Learning during the curriculum was the main source of information for the three areas mentioned in the study; also, the self-reading appeared to be significant source of knowledge (Tavolacci, et al., 2015). This was one of the motivations for our study to assess the practice of ICP protocols in diagnostic imaging departments, although, there is a one Palestinian university -of four universities that graduate MIT in Palestine- that teach infection control in its curriculum.

A cross-sectional study conducted on MIWs in India and eight other Middle Eastern and North African countries, aimed to investigate the response of the MIWs to the impact of COVID-19 pandemic on professional practice and also to investigate levels of fear and anxiety among MIWs, their study conclusion was, the workload altered in a bipolar way; increasing by 38% due to increased pressure on routine x-ray and CT scan as the initial and follow-up investigations for COVID-19 patients, and decreasing by 23% due to adherence to national and international guidance to minimize non-urgent work. Although PPE was readily available, MIWs were however concerned about becoming infected with COVID-19. Also, they discovered that 43.9% of respondents started experiencing work-related stress after the pandemic began, and 57.1% thought they could need professional support to deal with stress throughout the pandemic (Elshami, et al., 2021)

Level of knowledge about COVID-19 among HCWs in public hospitals and primary healthcare centers in Jeddah and Najran regions in Saudi Arabia, was assessed by researchers in Saudi Arabia, the majority of HCWs had inadequate or intermediate level of basic knowledge about COVID-19. This means that government agencies, such as the ministry of health, hospital administrations, universities and others, should plan and implement initiatives to promote HCWs knowledge (Alharbi & Mandoura, 2021; Al Sulayyim, et al., 2020).

The questionnaires in both previous mentioned studies (Alharbi & Mandoura, 2021; Al Sulayyim, et al., 2020); concerns on the COVID-19 virus symptoms, source, transmission and general measures, while in our study we put light on the source of infection and the daily practice of HCWs in diagnostic imaging departments to measure the knowledge of the team.

An Indonesian study conducted four days after the onset of COVID-19 pandemic in Indonesia (after the first two confirmed cases), to assess the knowledge about COVID-19 among HCWs by a questionnaire. Questions concerned on the transmission, symptoms and prevention of COVID-

19. Researchers reach to a conclusion that just over half of the surveyed HCWs had a good knowledge of COVID-19, the most notable finding in this study was that the knowledge among HCWs in emergency department was low; this finding lead to worry because the HCWs in emergency department are the first line to face suspected COVID-19 patients (Jamil, et al., 2020).

Because of the pivotal role that the diagnostic imaging department plays in patients care and direct contact with them, it is necessary to develop the department staff in the field of infection control and prevention and to identify possible sources of infection within the diagnostic imaging department.

Radiology department has many surfaces that can host infectious agents, patients who undergo these procedures can fall anywhere along the health continuum, and some at greater risk of infection. The types of microorganisms found in radiology departments is considered as an important factor affecting the patient health and safety, such as the presence and prevalence of multi-drug-resistant microbes, e.g. methicillin resistant staphylococcus aureus (MRSA), which can present challenges to reducing nosocomial infection and highlight the need for continued diligence in infection control (Zhang & Burbridge, 2011).

Previously, researchers focused on the sources of infections in diagnostic imaging departments, e.g., contamination of portable x-ray machines in intensive care units (ICU) with resistant bacteria, when there are poor infection control practices and may be a source of cross-infection and colonization (Levin, et al., 2009). Lead rubber aprons can be a source of infection when they are not cleaned sufficiently (Boyle & Strudwick, 2010). Radiographic markers can become highly contaminated with various organisms (Tugwell & Maddison, 2011).

X-ray tubes, control panels, imaging plates and radiographic cassettes tested in a study held in Italy in 2014 by samples taken from the surfaces of these equipment's with a results of 41.7% of the x-ray tubes, 91.7 of the control panels and imaging plates and 8 % of the radiographic cassettes were contaminated (Giacometti, et al., 2014). Keyboards, chairs of the patient changing rooms, headphones and the alarm control/buzzer can also be a source of infection as mentioned in a study targeted the surfaces of Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) as a potential source for transmission of hospital acquired infections (HAIs) (Palmqvist et al., 2019).

A study published in American College of Radiology (ACR) in 2014; prove that dictation microphones, computer mice, toilet seat and doorknobs can be a source of infection. The results of this study reveals that bacterial contamination of microphones and computer mice at radiologist workstations is common and greater than toilet seats and doorknobs, the most important finding in the study was that simple, rapid and inexpensive disinfection techniques with commercially available antiseptic pad completely eradicate workstation bacterial contamination (Duszak et al., 2014).

A cross-sectional study was conducted in 21 hospitals in Libya, among doctors and nurses working in emergency, ICUs and respiratory and infectious disease departments, where HCWs may directly or indirectly contact with suspected and/or confirmed COVID-19 patients. This study aimed to measure levels of knowledge and preparedness regarding COVID-19 among the participants, study's results showed that 44.4% of doctors and 31.7% of nurses knew the symptoms of COVID-19 infection, less than 70% of all participants knew the transmission mode of SARS-CoV-2, 52.7% of doctors and 45.3% of nurses knew about PPE and interestingly, only 43.2% of participants were aware of proper hand washing and hand hygiene techniques (Elhadi, et al., 2020).

Infection control knowledge and practices should be a priority for diagnostic imaging department particularly and hospital administration generally, especially in the pandemic of COVID-19 according to the role imaging in diagnosis of patients. To enhance knowledge in infection control practice we should start from the curriculum of the university, on-site training and improve of the guidelines for infection control in diagnostic imaging departments, which can enhance knowledge in infection control practice (Abdelrahman, et al., 2017; nyirenda et al., 2018; Akyurt, 2021).

1.4.Research Question

This study was conducted to answer those two questions;

1. How was the awareness, knowledge and practices of ICP in the diagnostic imaging departments in Palestinian's health system during COVID-19 pandemic?
2. What was the most source of infection with COVID-19 among MIWs in Palestine?

1.5.Objectives

1.1.1. Main Objective:

In this study, we aim to evaluate the impact of COVID-19 pandemic on MIWs; infection sources, awareness and commitment to relevant safety guidelines.

1.1.2. Specific Objectives:

a. Compare between the components of Palestinian's health care system (Governmental private and NGOs) in terms of the preparedness of ICP, PPE availability, team training,

confidence of the team in hospital's preparedness for COVID-19 and work load during the pandemic.

b. Knowing the number of infected MIWs in Palestine.
c. Source of knowledge about ICP, if it is from self-reading, training inwards, external training or was a part of the curriculum in the university.

Chapter 2: Materials and Methods

2.1. Study Design and Population

An institutional based cross-sectional descriptive study design, about the impact of COVID-19 pandemic on MIWs; infection sources, knowledge, awareness and practices of ICP measures, was conducted from July 15, 2021 to September 15, 2021, in diagnostic imaging departments in Palestinian health system, including governmental, private and NGOs hospitals. Ethical approval obtained from Deanship of research at Al-Quds University (Appendix 1).

2.2. Selection of Sample

Our sample targeted all MIWs in Palestinian's health care system, including governmental, private and NGOs hospitals.

2.2.1. Inclusion Criteria:

MIWs who worked in Palestinian diagnostic imaging departments during the COVID-19 pandemic were included in the study whether he/she was full or part time worker.

2.2.2. Exclusion Criteria:

We exclude workers in department admission office, cleaner, porters, secretaries and medical engineers, from the study.

2.2.3. Sources of data:

Data of this study was collected from diagnostic imaging departments in Palestinian health system, including governmental, private and NGOs hospitals. The distribution of MIWs in all hospitals as shown in (Table 2.1):

Table 2 1 Distribution of MIWs in Palestinian's Hospitals

Sector	**Radiologist**	**Radiology Residence**	**MIT**	**Nurses**
Governmental Sector	28	18	188	3
NGOs Sector	19	16	87	8
Private Sector	21	8	70	3
Total	**68**	**42**	**345**	**14**

2.2.4. Collection of data:

After review the literature, which include published papers and the biosafety protocols available from healthcare agencies, we developed a questionnaire of 39 questions in addition to the demographic data section (Appendix 2). These questions are divided as follows:

- Demographic information's (age, sex, education, working experience, occupational category and source of infection for MIWs).
- Hospital environment and preparedness **(**HEP**)**.
- Department environment and preparedness **(**DEP**)**.
- Staff preparedness and capability **(**SPC**)**, this divided into two sections:
    - Staff knowledge & awareness **(**SPCA**)**.
    - Staff practice & skills **(**SPCB**)**.
    -

Questionnaires were distributed to the MIWs in main Governmental, Private and NGOs Palestinian hospitals. We used a hard copy questionnaire to guarantee a maximum response, especially we felt that our questionnaire is slightly long and if we use an online form may affect the way that our colleagues fill it.

First we visited each diagnostic imaging department personally and talked to the head of department in each hospital, introduced our self, explained the purpose of the study and we demanded their cooperation to let the MIWs in department to fill the questionnaire.

However, because of the large number of colleagues in most departments with different shifts modes, we kept the copies at the Head of department office for at least one week. Then we collected the filled questionnaires.

About five hundred (500) copy of questionnaire were distributed to all hospitals, and we gathered two hundred and seven (207) respondents, two of them were excluded because demographic data were unfilled.

2.2.5. Data Analysis:

The 205 included questionnaires were exported to IBM SPSS Statistics for windows, version 23 for analysis. Descriptive statistics were used to describe the study variables. Frequency, percentage and mean scores were used to report the descriptive analysis. Statistical significance was considered for $P < 0.05$. The chi-square test and Kruskal-Wallis Test were used in the analysis.

The reliability of the knowledge, awareness and commitments to relevant safety guidelines was determined using Cronbach's alpha, which revealed scores HEP = 0.72, DEP = 0.79, SPCA = 0.70 and SPCB = 0.77.

Chapter 3: Results

205 (41%) valid responses were obtained out of a possible 500 participants from 34 hospitals in Palestine. Known that the health care system in Palestine is divided into three sectors; Governmental, Private and NGOS, the study was targeted the MIWs in main hospitals in the three sectors. Responses were 54.5% from the governmental hospitals, 27.2% from the private hospitals and 18.3% from the NGOs hospitals.

Female were 26.8% and 49.8% of the total participants were 20-30 years old. 81.9 % of respondents hold a Bachelor degree and only 1.0% of them had PhD. More than third of the respondents (41.2%) are less than five years in practice. 36.1% had a previous positive result during the pandemic, 61.6% of the affected MIWs were due to nosocomial cause. The demographic data of the respondents are presented in (Table 3.1).

Table 3. 1 Demographic characteristic of MIWs

		N (%)
Gender	Male	150 (73.2)
	Female	55 (26.8)
Age	20-30	102 (49.8)
	31-40	71 (34.6)
	41-50	22 (10.7)
	≥51	10 (4.9)
Education	Diploma	9 (4.4)
	Bachelor	167 (81.9)
	Master	26 (12.7)
	PhD	2 (1)
Years in Practice	0-5	84 (41.2)
	6-10	69 (33.8)
	11-15	22 (10.8)
	≥16	29(14.2)
Occupation	MIT	175 (85.4)
	Radiologist	17 (8.3)
	Rad. Residence	7 (3.4)
	Rad. Nurse	6 (2.9)
Do you had a previous COVID-19 positive result	No	131 (63.9)
	Yes	74 (36.1)
If "YES" where did you get the infection from?	Nosocomial (Hospital)	45 (61.6)
	Home	12 (16.4)
	Social Activity	7 (9.6)
	Don't Know	9 (12.3)

Table 3.2 represents the measurements of HEP, while 79.2% of the total participants, reveals that their hospital is an authorized facility for COVID-19 patients with no significant difference between health sectors, 63.2 % of participants feel confidence in hospital preparedness for COVID-19, with a significance contrast of $P < 0.001$ between health care sectors, the lowest confidence were among MIWs in governmental sector (50.5%).

Hospitals in Palestinian health care system had made available adequate PPE in all sectors with no significance difference, but the most were in NGOS sector (97.0%). Medical imaging department informed by the nurse or physician whether the patient was a suspected or confirmed COVID-19 case before he arrived to diagnostic imaging department, with a lowest percent in governmental sector (84.5%) which is also very good (Table 3.2).

Table 3. 2 Measurements of Hospital Environment and Preparedness (HEP)

Hospital Environment and Preparedness (HEP)		Hospital Sector				P-value by Chi Square
		Governmental	Private	NGOs	Total	
		N (%)	N (%)	N (%)	N (%)	
Is your organization is an authorized facility for COVID-19 patients?	No	26 (24.8)	9 (16.4)	6 (16.2)	41 (20.8)	0.345
	Yes	79 (75.2)	46 (83.6)	31 (83.8)	156 (79.2)	
Are you confidence in hospital preparedness for COVID-19?	No	54 (49.5)	16 (29.1)	4 (10.8)	74 (36.8)	**<.001**
	Yes	55 (50.5)	39 (70.9)	33 (89.2)	127 (63.2)	
In your place of work, is there a department for infection control?	No	21 (19.3)	16 (29.1)	6 (16.2)	43 (21.4)	0.244
	Yes	88 (80.7)	39 (70.9)	31 (83.80	158 (78.6)	
Hospital has made available adequate PPE for work during the COVID-19 outbreak	No	15 (16)	3 (6.3)	1 (3)	19 (10.9)	0.059
	Yes	79 (84)	45 (93.8)	32 (97)	156 (89.1)	
Before the patient sent to you from the triage, ER or department, do you informed from the nurse or physician if the patient suspected or confirmed case of COVID-19?	No	17 (15.5)	3 (5.5)	2 (5.4)	22 (10.9)	0.075
	Yes	93 (84.5)	52 (94.5)	35 (94.6)	180 (89.1)	
To raise the preparedness of the institution, you should rescheduling elective appointments to focus on urgent and emergency cases	No	4 (4.6)	0 (0)	1 (3.1)	5 (3)	0.317
	Yes	83 (95.4)	49 (100)	31 (96.9)	163 (97)	
There was communication with occupational healthcare services for testing, treating and quarantine of staff that exposed to the virus from either the healthcare setting or community?	No	10 (11.6)	5 (10.6)	1 (3.4)	16 (9.9)	0.433
	Yes	76 (88.4)	42 (89.4)	28 (96.6)	146 (90.1)	

Respondents mostly agree (97.0%) with reschedule elective appointments to focus on urgent cases in all three sectors. There was communication with occupational healthcare services for testing, treating and quarantine of staff that exposed to the virus from either the healthcare setting or community in all sectors, while in NGOs was higher than others (96.6%) (Table 3.2).

In department environment preparedness DEP (Table 3.3), there was a significant difference in many responses to related questions. The lowest feel about whether the department is capable of dealing with COVID-19 patients was in the governmental sector (52.9%), then in the private sector (69.2%), while in NGOs was the best (88.9%) with a significant P = 0.001.

In their description to the workload after COVID-19 pandemic, 45.9 % of respondents in NGOs revealed that the workload was increased, comparing to the participants in governmental and private sectors, which was 66.7% and 70.4% respectively, with a significance of P = 0.039.

Supplies necessary for adherence to hand hygiene are readily accessible in private diagnostic imaging departments, as 100% of respondents in private sector revealed, while 94.4% and 86.5% in NGOs and Governmental diagnostic imaging departments, respectively, P = 0.012.

More than half of the respondents (53.8%) in governmental sector, report that after the onset of COVID-19 pandemic, their department was allocate a separate x-ray room for suspected or confirmed infected cases, comparing with private and NGOs (40.4% and 27.6% respectively), with a significance of P = 0.033.

Majority of the participants reported that they clean radiological equipment's and their accessories on a routine basis in all sectors, while the lowest ratio was in governmental sector (88.0%). In all three sectors there was a nearby ratio, that report there was a way supported by the institution for waste disposal related to contaminated protective suits and equipment during the COVID-19 pandemic in the diagnostic imaging departments in governmental, private and NGOs hospitals (61.7%, 72.7% and 75.0% respectively).

Staff preparedness and capability was a very important issue in this study, as we tried to measure how much the MIWs prepared and capable to act in COVID-19 pandemic. A nine questions were designed to assess the MIWs knowledge and awareness (Table 3.4).

There was only 29.0% of respondents in governmental sector reported that they had a training on handling suspected or confirmed COVID-19 patients, while in private and NGOs sectors the ratio was 59.6% and 57.6% respectively, with significance P < 0.001.

With no noted significance between all sectors, there was 30.3% of respondents revealed that the COVID-19 is transmitted via airborne, 33.8% via droplet, 34.3% via contact and 12.4% they don't know the way of transmission.

All respondents in the three sectors, reported that they have knowledge about precautions required when dealing with suspected/confirmed COVID-19 cases, with a minimum of 59.8% in governmental sector which is also a very good.

There was 83.1% of respondents in governmental sector report that they have knowledge about types of disinfectants and how to prepare and use them, while 90.9% in NGOs and 97.6% in private sector, with a significance of P = 0.048.

26.6% of MIWs in governmental sectors reported that In-Hospital training was their source of information about COVID-19 pandemic, which is a significance difference comparing to other health care sectors (Private & NGOs), where 49.1% and 48.6% respectively. From all respondents, there was 58.7% revealed that their source of information about, P = 0.005 (Table 3.4).

Table 3. 3 Measurements of Department Environment and Preparedness (DEP)

Department Environment and Preparedness (DEP)		**Hospital Sector**				**P-value by Chi Square**
		Governmental	**Private**	**NGOs**	**Total**	
		N (%)	N (%)	N (%)	N (%)	
Does your department is capable of dealing with COVID-19 patients?	No	41 (47.1)	16 (30.8)	4 (11.1)	61 (34.9)	**0.001**
	Yes	46 (52.9)	36 (69.2)	32 (88.9)	114 (65.1)	
Is there a representative person for the infection control department in diagnostic imaging department?	No	56 (50.9)	26 (47.3)	16 (43.2)	98 (48.5)	0.705
	Yes	54 (49.1)	29 (52.7)	21 (56.8)	104 (51.5)	
We have department policies, strategies and developed standard procedures based on local, national and international guidelines	No	21 (28.4)	7 (16.3)	3 (9.7)	31 (20.9)	0.067
	Yes	53 (71.6)	36 (83.7)	28 (90.3)	117 (79.1)	
Which of the following best describes your workload after the COVID-19 pandemic? (we mentioned here the “Increased” answer	No	35 (33.3)	16 (29.6)	20 (54.1)	71 (36.2)	**0.039**
	Yes	70 (66.7)	38 (70.4)	17 (45.9)	125 (63.8)	
Work from home was arranged for radiologists (Provide home workstation and utilizing video conferencing software for meeting) in order to minimize team in the department and to safe work forces	No	36 (40.4)	21 (46.7)	11 (42.3)	68 (42.5)	0.789
	Yes	53 (59.6)	24 (53.3)	15 (57.7)	92 (57.5)	
Due to the pandemic; your shifts mode changed, as a step of the management of work force of the department	No	17 (18.9)	11 (25)	7 (24.1)	35 (21.5)	0.669
	Yes	73 (81.1)	33 (75)	22 (75.9)	128 (78.5)	
Supplies necessary for adherence to hand hygiene are readily accessible in department	No	12 (13.5)	0 (0)	2 (5.6)	14 (7.8)	**0.012**
	Yes	77 (86.5)	54 (100)	34 (94.4)	165 (92.2)	
After the onset of the pandemic, your department allocate a separated x-ray room for suspected/confirmed COVID-19 patients	No	43 (46.2)	28 (59.6)	21 (72.4)	92 (54.4)	**0.033**
	Yes	50 (53.8)	19 (40.4)	8 (27.6)	77 (45.6)	
After the onset of the pandemic, your department allocate a separated portable x-ray room for suspected/confirmed COVID-19 patients	No	39 (41.1)	19 (40.4)	11 (33.3)	69 (39.4)	0.727
	Yes	56 (58.9)	28 (59.6)	22 (66.7)	106 (60.6)	

After the onset of the pandemic, your department allocate a separated Ultrasound machine room for suspected/confirmed COVID-19 patients	No	56 (64.4)	23 (50)	16 (47.1)	95 (56.9)	0.122
	Yes	31 (35.6)	23 (50)	18 (52.9)	72 (43.1)	
We clean all radiological equipment and accessories on a routine basis (e.g. weekly), whether soiled or not soiled.	No	11 (12)	1 (2)	0 (0)	12 (6.9)	**0.02**
	Yes	81 (88)	50 (98)	30 (100)	161 (93.1)	
Was there a way supported by the Institution for waste disposal related to contaminated protective suits and equipment during the COVID-19 epidemic in the radiology departments?	No	41 (38.3)	15 (27.3)	9 (25)	65 (32.8)	0.199
	Yes	66 (61.7)	40 (72.7)	27 (75)	133 (67.2)	

About 33.3% of all respondents reported that hand hygiene means cleaning hands by using hand washing (washing hands with soap and water). And 12.1% reported Antiseptic hand wash is the meaning of hand hygiene. And 25.1% revealed that hand hygiene means cleaning hands with antiseptic hand rub (i.e. alcohol-based hand sanitizer including foam or gel), or surgical hand antisepsis, while the higher ratio of respondents (39.7%) reported that any one of three ways can be considered as hand hygiene (Table 3.4).

Almost all respondents in the governmental, private and NGOs knows that wearing gloves does not replace the need for hand hygiene, with a response of about 76.0%, 84.0% and 84.4% respectively, P = 0.406. Also, 100.0% of respondent answers in all three health sectors agreed that for confirmed or suspected COVID-19 cases, portable ultrasound examinations are preferred. (Table 3.4).

Table 3. 4 Measurements of Staff preparedness and capability A (SPCA)

Staff Knowledge & Awareness **SPCA**		**Hospital Sector**				**P-value by Chi Square**
		Governmental	**Private**	**NGOs**	**Total**	
		N (%)	N (%)	N (%)	N (%)	
Have you had any training for handling suspected/infected COVID-19 patients?	No	66 (71)	21 (40.4)	14 (42.4)	101 (56.7)	**<0.001**
	Yes	27 (29)	31 (59.6)	19 (57.6)	77 (43.3)	
COVID-19 is transmitting via; Airborne	No	75 (68.8)	39 (70.9)	26 (70.3)	140 (69.7)	0.959
	Yes	34 (31.2)	16 (29.1)	11 (29.7)	61 (30.3)	
COVID-19 is transmitting via; Droplet	No	78 (71.6)	32 (58.2)	23 (62.2)	133 (66.2)	0.197
	Yes	31 (28.4)	23 (41.8)	14 (37.8)	68 (33.8)	
COVID-19 is transmitting via; Contact	No	69 (63.3)	34 (61.8)	29 (78.4)	132 (65.7)	0.194
	Yes	40 (36.7)	21 (38.2)	8 (21.6)	69 (34.3)	
COVID-19 is transmitting via; I do not Know	No	96 (88.1)	50 (90.9)	30 (81.1)	176 (87.6)	0.364
	Yes	13 (11.9)	5 (9.1)	7 (18.9)	25 (12.4)	
I have knowledge about precautions required when dealing with suspected/confirmed COVID-19 cases.	No	4 (4.2)	1 (2)	0 (0)	5 (2.8)	0.197
	Yes	91 (95.8)	48 (98)	36 (100)	175 (97.2)	
I have knowledge about types of disinfectants, how to prepare and use them.	No	15 (16.9)	1 (2.4)	3 (9.1)	19 (11.6)	**0.048**
	Yes	74 (83.1)	41 (97.6)	30 (90.9)	145 (88.4)	
Your source of information about Infection Control and Prevention was from Self-reading	No	39 (35.8)	27 (49.1)	17 (45.9)	83 (41.3)	0.215
	Yes	70 (64.2)	28 (50.9)	20 (54.1)	118 (58.7)	
Your source of information about Infection Control and Prevention was from In-Hospital Training	No	80 (73.4)	28 (50.9)	19 (51.4)	127 (63.2)	**0.005**
	Yes	29 (26.6)	27 (49.1)	18 (48.6)	74 (36.8)	
Your source of information about Infection Control and Prevention was from External Training	No	101 (92.7)	52 (94.5)	35 (94.6)	188 (93.5)	0.861
	Yes	8 (7.3)	3 (5.5)	2 (5.4)	13 (6.5)	
Your source of information about Infection Control and Prevention was from University Curriculum	No	102 (93.6)	54 (98.2)	37 (100)	193 (96)	0.142
	Yes	7 (6.4)	1 (1.8)	0 (0)	8 (4)	
	No	76	33	23	132	0.343

Hand Hygiene means cleaning your hands by using: Hand washing (washing hands with soap and water).		(71)	(60)	(63.9)	(66.7)	
	Yes	31 (29)	22 (40)	13 (36.1)	66 (33.3)	
Hand Hygiene means cleaning your hands by using: Antiseptic hand wash.	No	91 (84.3)	49 (89.1)	35 (97.2)	175 (87.9)	0.112
	Yes	17 (15.7)	6 (10.9)	1 (2.8)	24 (12.1)	
Hand Hygiene means cleaning your hands by using: Antiseptic hand rub	No	78 (72.2)	45 (81.8)	26 (72.2)	149 (74.9)	0.378
	Yes	30 (27.8)	10 (18.2)	10 (27.8)	50 (25.1)	
Hand Hygiene means cleaning your hands by using: Any one of the above considers hand hygiene	No	67 (62)	33 (60)	20 (55.6)	120 (60.3)	0.788
	Yes	41 (38)	22 (40)	16 (44.4)	79 (39.7)	
Wearing gloves does not replace the need for hand hygiene	True	73 (76)	42 (84)	27 (84.4)	142 (79.8)	0.406
	False	23 (24)	8 (16)	5 (15.6)	36 (20.2)	
For confirmed or suspected COVID-19 cases, portable ultrasound examinations are preferred	No	0 (0)	0 (0)	0 (0)	0 (0)	-
	Yes	63 (100)	48 (100)	29 (100)	140 (100)	

In all healthcare settings, preventing infectious disease transmission among HCWs and patients is a crucial component of safe healthcare delivery, so HCWs must use proper PPE when exposed to a patient with suspected or confirmed COVID-19 or even a minimum protection level during the pandemic.

Table 3.5, shows the responses of all participants about their knowledge of the required protection level for healthcare staff.

Table 3. 5 Response to the required protection level for Health Care Staff

	Health Sector		Surgical mask %	Surgical cap %	Gloves %	Eye protection %	Shoe cover %	Gown %	N95/99 or FFP2/3 %
Minimum requirement	Governmental	No	27.7	87.1	37.6	85.1	89.1	76.2	80.2
		Yes	72.3	12.9	62.4	14.9	10.9	23.8	19.8
Suspected covid-19		No	33.7	69.3	25.7	57.4	62.4	29.7	47.5
		Yes	66.3	30.7	74.3	42.6	37.6	70.3	52.5
Confirmed covid-19		No	33.3	34.3	16.7	28.4	29.4	22.5	17.6
		Yes	66.7	65.7	83.3	71.6	70.6	77.5	82.4
Minimum requirement	Private	No	40	87.3	36.4	90.9	92.7	72.7	74.5
		Yes	60.0	12.7	63.6	9.1	7.3	27.3	25.5
Suspected covid-19		No	32.7	63.6	21.8	56.4	72.7	29.1	47.3
		Yes	67.3	36.4	78.2	43.6	27.3	70.9	52.7
Confirmed covid-19		No	43.6	32.7	20	21.8	25.5	23.6	12.7
		Yes	56.4	67.3	80.0	78.2	74.5	76.4	87.3
Minimum requirement	NGOs	No	24.2	87.9	30.3	84.8	81.8	72.7	84.8
		Yes	75.8	12.1	69.7	15.2	18.2	27.3	15.2
Suspected covid-19		No	30.3	51.5	12.1	33.3	60.6	24.2	33.3
		Yes	69.7	48.5	87.9	66.7	39.4	75.8	66.7
Confirmed covid-19		No	39.4	27.3	9.1	9.1	12.1	12.1	6.1
		Yes	60.6	72.7	90.9	90.9	87.9	87.9	93.9

Also, we measured staff preparedness and capability by measuring how much staff practice (SPCB) infection control guidelines. We use 11 questions to test some practices and skills of MIWs during COVID-19 pandemic (Table 3.6).

Only 65.1% of respondents in governmental sector, reported that they had trained on hand hygiene, comparing to 87.3% and 91.9% in private and NGOs respectively, with significance of $P < 0.001$. Also 54.3% of participants in governmental sector revealed that they had training on correct use of PPE, while 91.7% in NGOs, with a significance of $P < 0.001$.

A significance difference ($P = 0.017$) between three sectors, in their practice of covering all sponge immobilizers and bellows must be covered with a wrap (Plastic, papered…etc.), and the wrap should be changed between each patient in order to avoid or prevent infection with COVID-19, with a lowest response in governmental sector (86.9%) comparing to 100% in private sector.

Table 3. 6 Measurements of Staff preparedness and capability B (SPCB)

Staff Practice & Skills SPCB		Hospital Sector				P-value by Chi Square
		Governmental	Private	NGOs	Total	
		N (%)	N (%)	N (%)	N (%)	
I already trained on hand hygiene	No	38 (34.9)	7 (12.7)	3 (8.1)	48 (23.9)	**<0.001**
	Yes	71 (65.1)	48 (87.3)	34 (91.9)	153 (76.1)	
I already trained on correct use of PPE (Donning and Doffing)	No	48 (45.7)	13 (23.6)	3 (8.3)	64 (32.7)	**<0.001**
	Yes	57 (54.3)	42 (76.4)	33 (91.7)	132 (67.3)	
In order to avoid or prevent infection with COVID-19; Patients with severe cough can wait in the waiting area for his turn	No	74 (71.2)	40 (75.5)	30 (81.1)	144 (74.2)	0.481
	Yes	30 (28.8)	13 (24.5)	7 (18.9)	50 (25.8)	
In order to avoid or prevent infection with COVID-19; You should never clean up spills of body fluid and leave it to the cleaner at all times	No	63 (61.2)	32 (61.5)	27 (75)	122 (63.9)	0.304
	Yes	40 (38.8)	20 (38.5)	9 (25)	69 (36.1)	
In order to avoid or prevent infection with COVID-19; Sinks can be used to discard patient secretions or excretions.	No	60 (65.2)	41 (78.8)	26 (81.3)	127 (72.2)	0.096
	Yes	32 (34.8)	11 (21.2)	6 (18.8)	49 (27.8)	
In order to avoid or prevent infection with COVID-19; All sponge immobilizers and bellows must be covered with a wrap (Plastic, Paper,…etc.), and the wrap should be changed between each patient	No	14 (13.1)	0 (0)	2 (5.7)	16 (8.3)	**0.017**
	Yes	93 (86.9)	51 (100)	33 (94.3)	177 (91.7)	
In order to avoid or prevent infection with COVID-19; You should clean the radiographic table after each procedure	No	7 (6.7)	2 (3.7)	0 (0)	9 (4.7)	0.244
	Yes	97 (93.3)	52 (96.3)	35 (100)	184 (95.3)	
In order to avoid or prevent infection with COVID-19; Do you ask the patient or his companion to put-on his mask before interring the department?	No	5 (4.5)	0 (0)	1 (2.8)	6 (3)	0.269
	Yes	105 (95.5)	55 (100)	35 (97.2)	195 (97)	
Before putting on gloves, I wash my hands or disinfect with alcohol.	No	12 (10.9)	13 (23.6)	2 (5.4)	27 (13.4)	**0.022**
	Yes	98 (89.1)	42 (76.4)	35 (94.6)	175 (86.6)	
After removing gloves, I wash my hands or disinfect with alcohol.	No	2 (1.8)	1 (1.8)	0 (0)	3 (1.5)	0.711
	Yes	108 (98.2)	54 (98.2)	37 (100)	199 (98.5)	
I changed the surgical mask daily;	No	1 (0.9)	0 (0)	0 (0)	1 (0.5)	0.663
	Yes	109 (99.1)	54 (100)	36 (100)	199 (99.5)	
For ultrasound procedures, probe covers should be used for all patients if possible; proper disinfection of U/S machine and couch after each patient should be done as per standard protocol.	No	10 (9.5)	4 (7.5)	3 (8.6)	17 (8.8)	0.917
	Yes	95 (90.5)	49 (92.5)	32 (91.4)	176 (91.2)	
CT scanning for suspected or confirmed cases should be delayed until the end of the shift to reduce the number of contact persons with patient.	No	0 (0)	0 (0)	0 (0)	0 (0)	-
	Yes	87 (100)	43 (100)	26 (100)	156 (100)	
Two medical imaging technologists perform CT scanning (One in the operating room and the other inside & outside scanning room).	No	0 (0)	0 (0)	0 (0)	0 (0)	-
	Yes	67 (100)	29 (100)	20 (100)	116 (100)	
Radiologists and medical imaging technologist should full use the PACS and RIS systems (Paper-Less) in order to minimize contact with patients and other hospital staff.	No	0 (0)	0 (0)	0 (0)	0 (0)	-
	Yes	99 (100)	52 (100)	34 (100)	185 (100)	

Cover all portable X-ray cassettes and grids with a disposal, clear plastic cassette cover to prevent contamination.	No	11 (10)	5 (9.1)	4 (10.8)	20 (9.9)	0.963
	Yes	99 (90)	50 (90.9)	33 (89.2)	182 (90.1)	
Between each patient that has undergone examination, thoroughly clean X-ray/US tables and any other items that exposed to patients.	No	4 (3.6)	1 (1.8)	1 (2.7)	6 (3)	0.806
	Yes	106 (96.4)	54 (98.2)	36 (97.3)	196 (97)	

Only 76.4% of participants in private sector, revealed that they wash their hands or disinfect with alcohol before they put-on gloves, while in governmental and NGOs (89.1% and 94.6% respectively), P = 0.022.

In all three health sectors, all respondents (100.0%) reported that; CT scanning for suspected or confirmed cases should be delayed until the end of the shift to reduce the number of contact persons with patient and Two medical imaging technologists perform CT scanning (One in the operating room and the other inside & outside scanning room) also radiologists and medical imaging technologist should full use the PACS and RIS systems (Paper-Less) in order to minimize contact with patients and other hospital staff.

All questions used to examine HEP, DEP, SPCA and SPCB were converted to yes/no questions, and we counted how many “Yes” and “No” answers for each question. HEP’s question were 7 considering 0= the worst and 7= the best (mean=5.40, SD= 1.64), DEP’s questions were 12 considering 0 = worst, 12= best (mean = 6.92, SD= 2.791), SPCA were 38 questions (0= worst and 38= best) the mean were 17.26, SD= 5.409 and SPCB were 17 questions (0= worst, 17= best), the mean were 12.85, SD= 2.082. Figures (3.1), (3.2), (3.3) and (3.4) down shows frequencies of these answers.

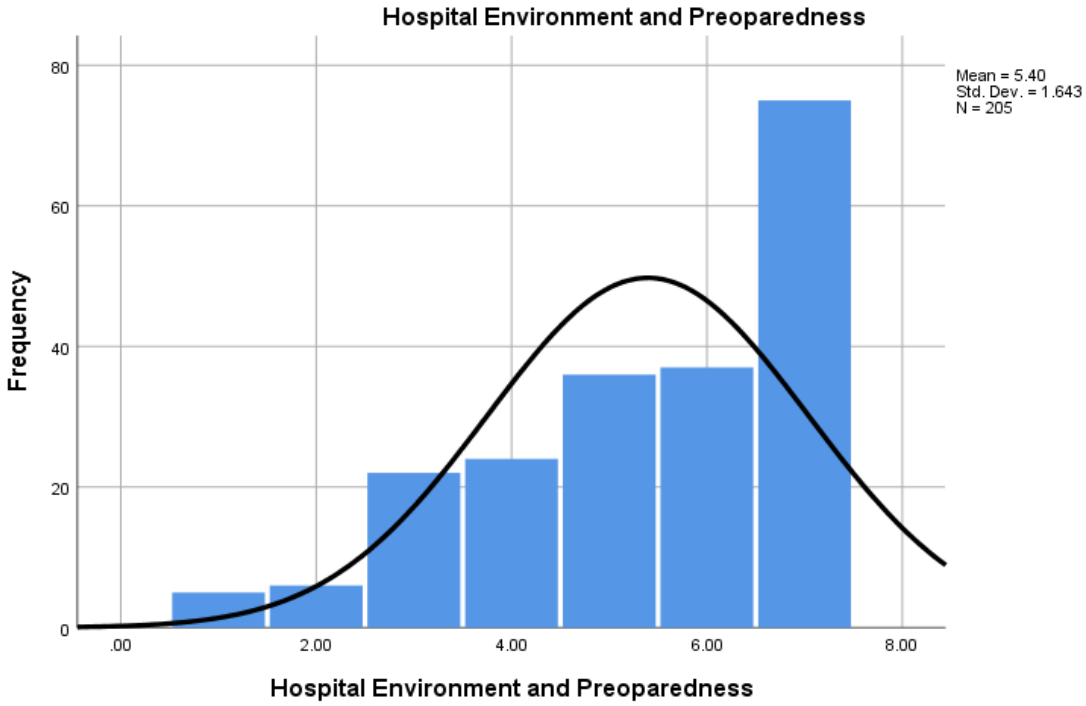

Figure 3 1 Distribution of MIWs in relation to HEP

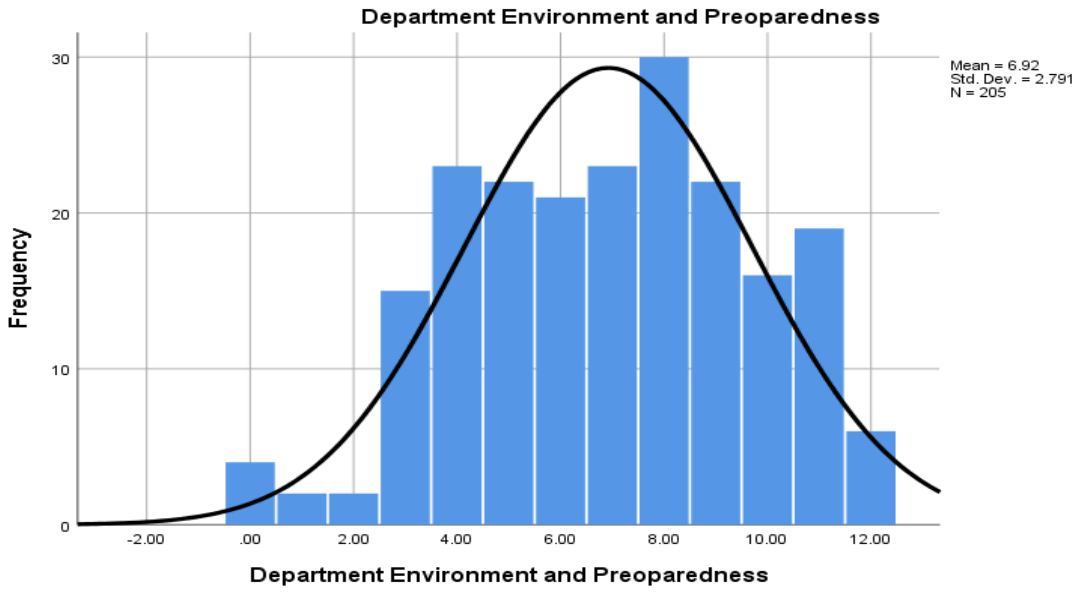

Figure 3 2 Distribution of MIWS in relation to DEP

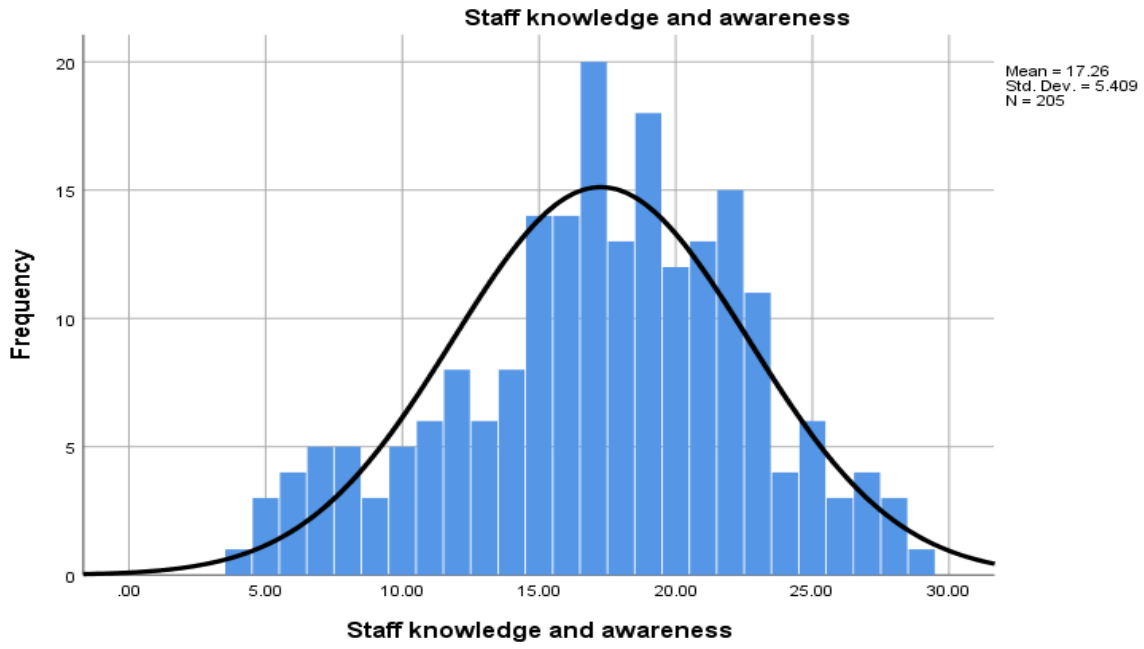

Figure 3 3 Distribution of MIWS in relation to SPCA

Figure 3 4 Distribution of MIWS in relation to SPCB

According to statistical analysis there was no relationship between infections among MIWs and the radiology sub-unit they work in (Table 3.7). Also there was no significant association between health care sectors related to the number of infected MIWs, while the governmental sector had the least percent of infected MIWs (31.8%) (Table 3.8).

A significant association (P=0.001) was noted between responses related to their belief of capability of their department to deal with COVID-19 patients, there were 88.9% of NGOs participants and 52.9% of governmental participants revealed that their department is capable of dealing of COVID-19 patients, while there were 86.7% of participants in NGOs reported that the cause of their infection was due to nosocomial, while in governmental and private there were 58.8% and 50.0% respectively (Table 3.8).

Table 3. 7 Relationship between MIW's sub-unit and Infection

Radiology Sub-Unit		**Do you had a previous COVID-19 positive result**		**P-value by Chi Square**
		No	Yes	
		Count	Count	
Routine & Flouro	Yes	108	63	0.619
CT scan	Yes	56	37	0.316
MRI scan	Yes	17	10	0.913
U/S	Yes	15	4	0.152

Table 3. 8 Relationship between infection and its cause Vs. Health care sector

		Hospital Sector			**P-value by Chi Square**
		Governmental	**Private**	**NGOs**	
		N (%)	N (%)	N (%)	
Do you had a previous COVID-19 positive result	No	75 (68.2)	31 (56.4)	22 (59.5)	0.286
	Yes	35 (31.8)	24 (43.6)	15 (40.5)	
If "YES" where did you get the infection from?	Nosocomial	20 (58.8)	12 (50)	13 (86.7)	0.172
	Home	8 (23.5)	4 (16.7)	0 (0)	
	Social Activity	3 (8.8)	4 (16.7)	0 (0)	
	Don't Know	3 (8.8)	4 (16.7)	2 (13.3)	
Does your department is capable of dealing with COVID-19 patients?	No	41 (47.1)	16 (30.8)	4 (11.1)	**0.001**
	Yes	46 (52.9)	36 (69.2)	32 (88.9)	
Is there a representative person for the infection control department in diagnostic imaging department?	No	56 (50.9)	26 (47.3)	16 (43.2)	0.705
	Yes	54 (49.1)	29 (52.7)	21 (56.8)	

Years in practice for MIWs doesn't has any effect on the SPCA & SPCB (Figures 3.5 and 3.6).

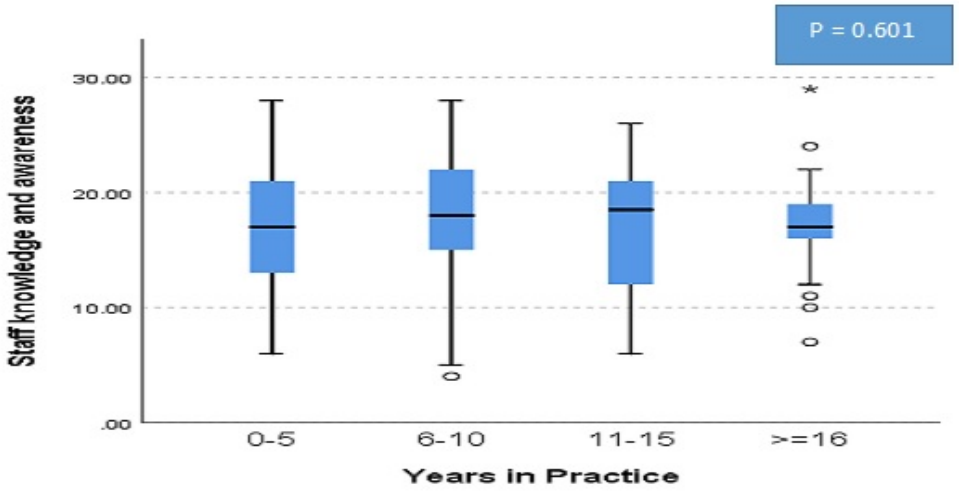

Figure 3 5 Distribution of SPCA in relation to Years in practice

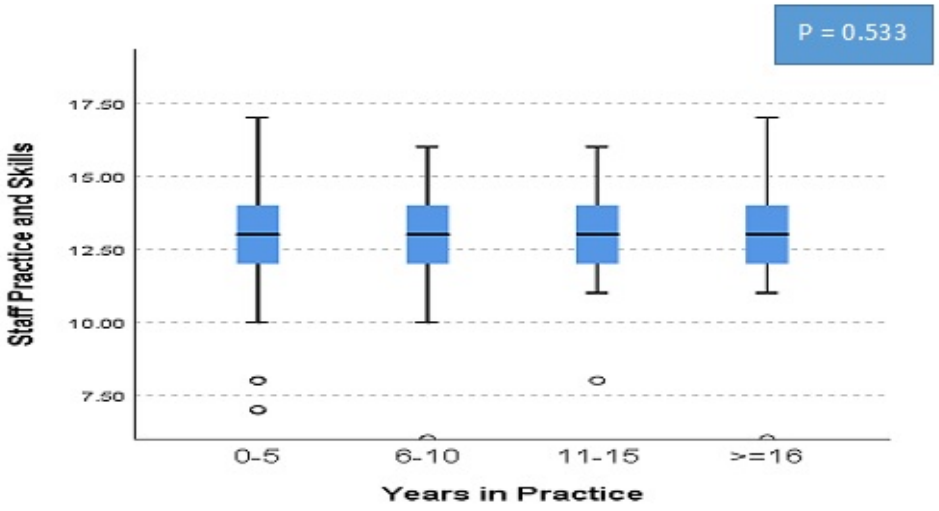

Figure 3 6 Distribution of SPCB in relation to Years in practice

Availability of a representative person for the infection control in the diagnostic imaging department has no effect on the SPCA across the three health care sectors, while it has effect on SPCB among health care sectors with a significant of P= 0.028 (Figure 3.7 and 3.8), this was measured by using Independent-Samples Mann-Whitney U Test.

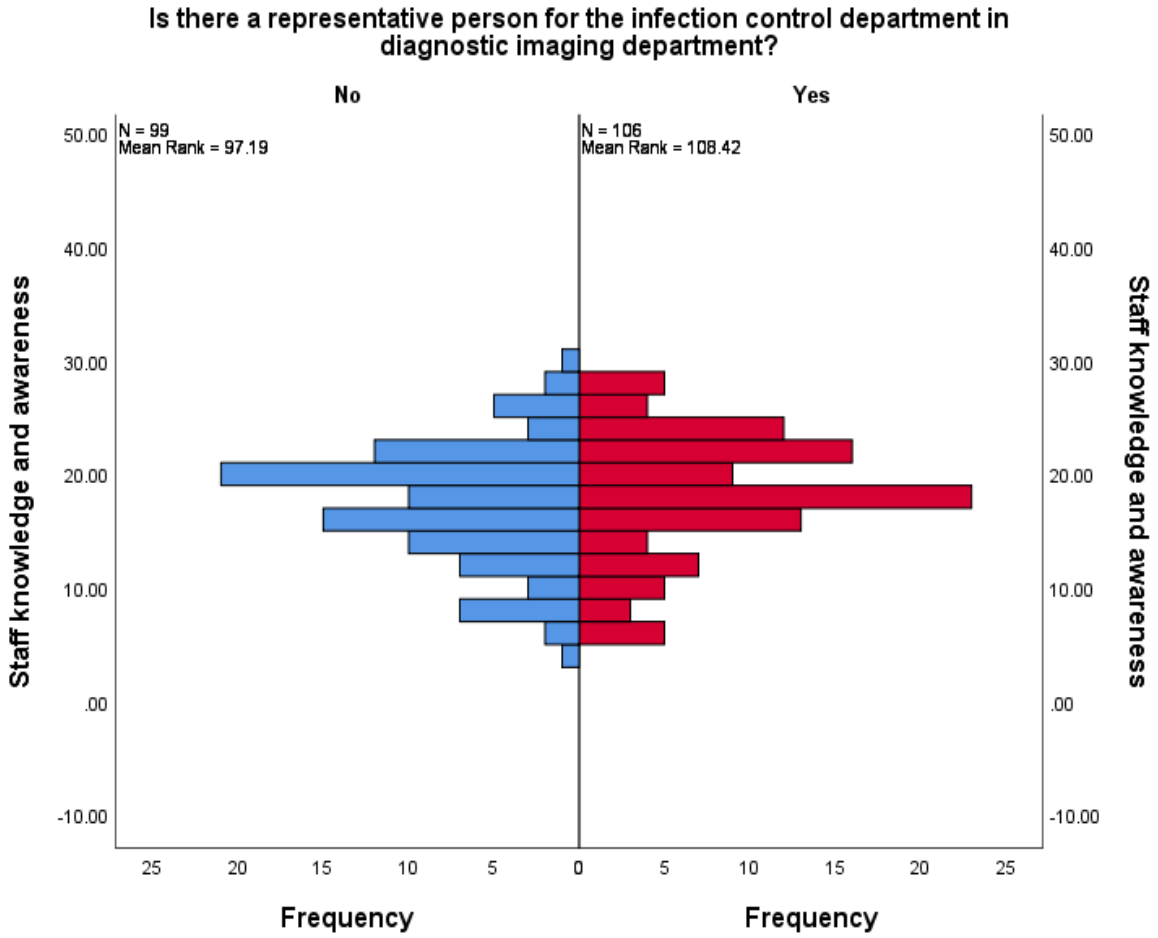

Figure 3 7 Effect on SPCA according to availability of representative person for the ICP in diagnostic imaging department.

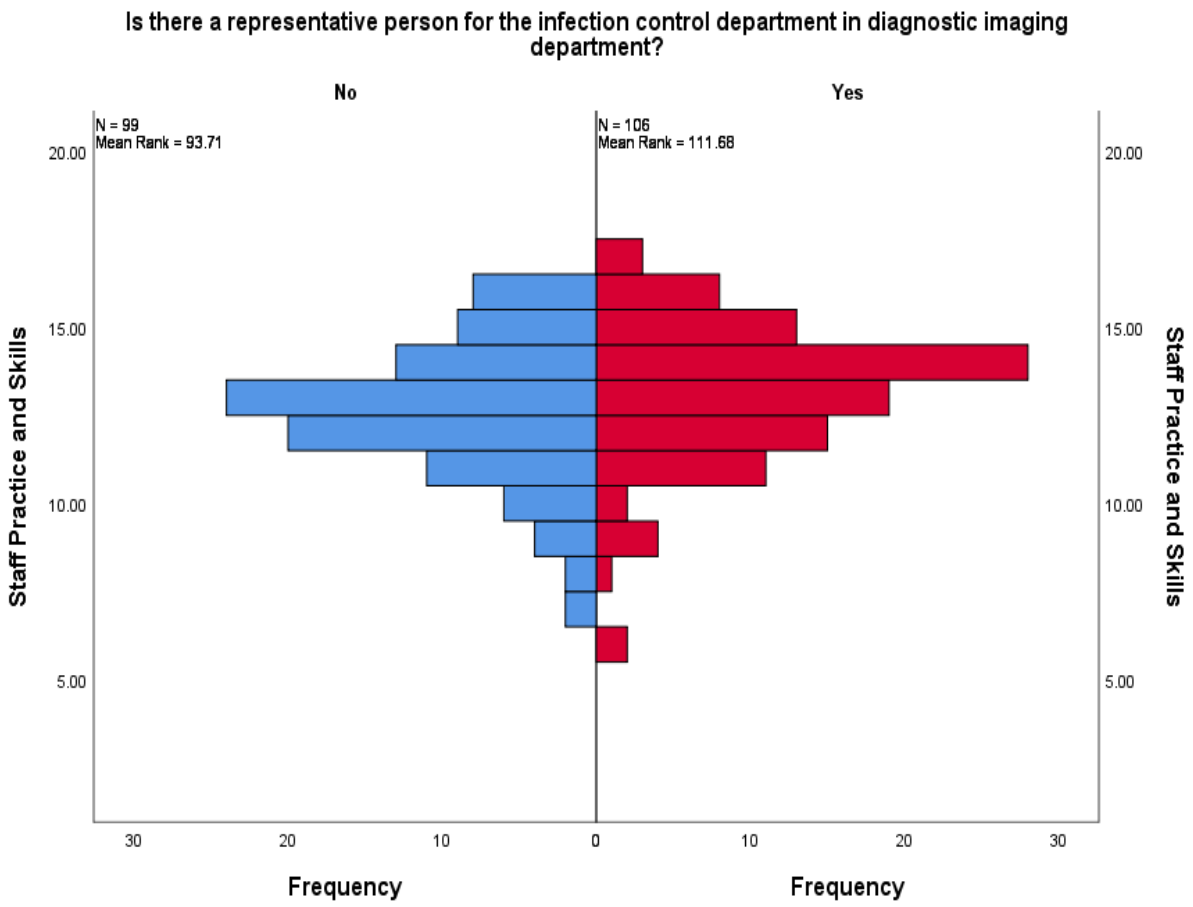

Figure 3 8 Effect on SPCB according to availability of representative person for the ICP in diagnostic imaging department.

SPCA was not the same across health care sectors (P=0.030), but SPCB is the same across health care sectors (Figure 3.9), this was also measured using Independent-Samples Mann-Whitney U Test.

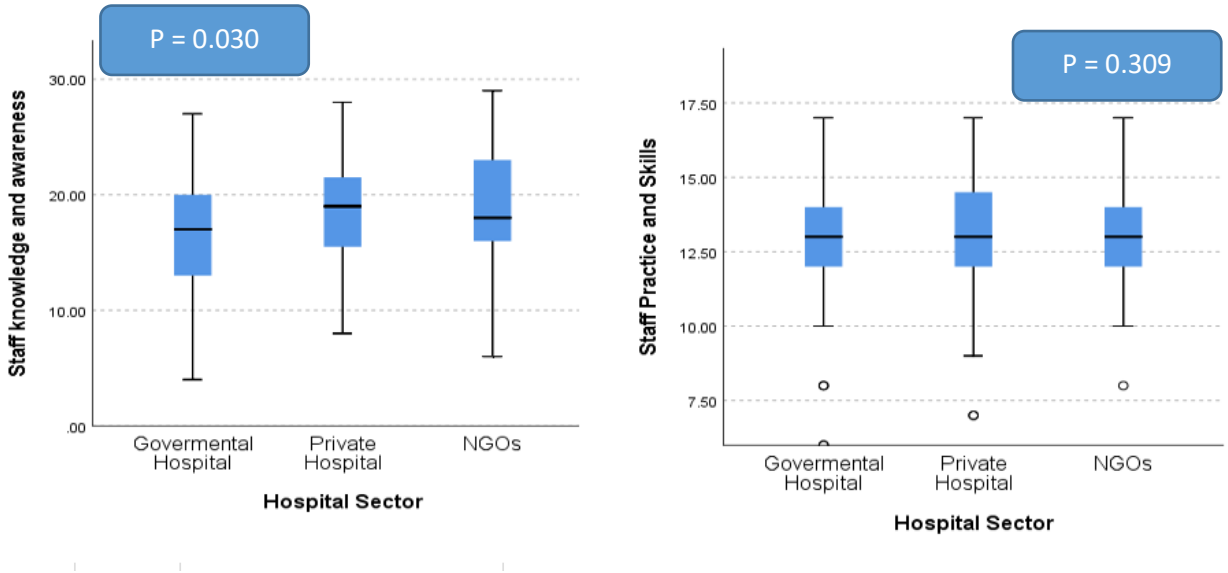

Figure 3 9 Distribution of SPCA & SPCB in relation to Hospital Sectors

There was a significant difference in the effect of HEP across Health care sectors (P = 0.003) and also in the effect of DEP (P = 0.040), this was also calculated by Independent-Samples Kruskal-Wallis Test, (Figure 3.10)

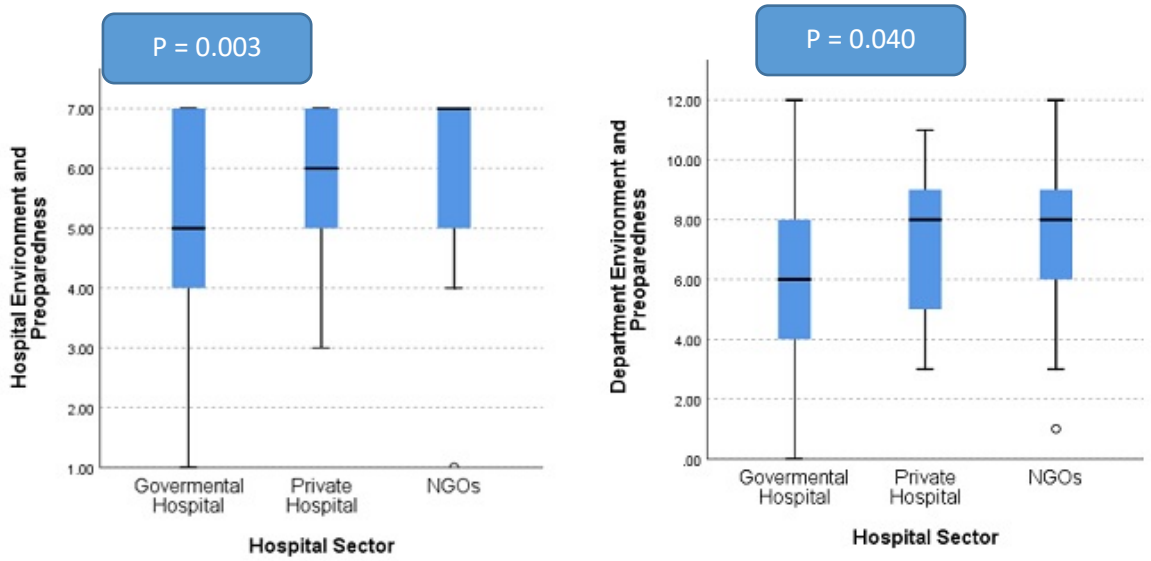

Figure 3 10 Distribution of HEP & DEP in relation to Hospital Sector

By using Kruskal-Wallis Test to measure the relationship between SPCA & SPCB from a side and age of MIW, level of education, years in practice, and occupation from other side, we find no correlation between them, figures (3.11, 3.12, 3.13 and 3.14) down are examples for this correlation.

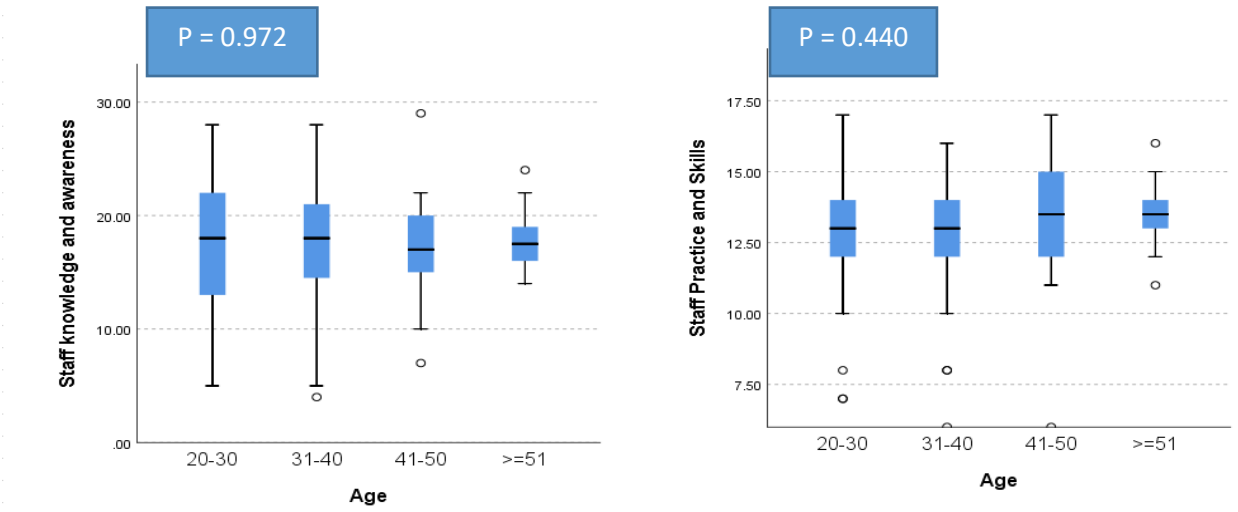

Figure 3 11 Distribution of SPCA & SPCB in relation to MIW's Age

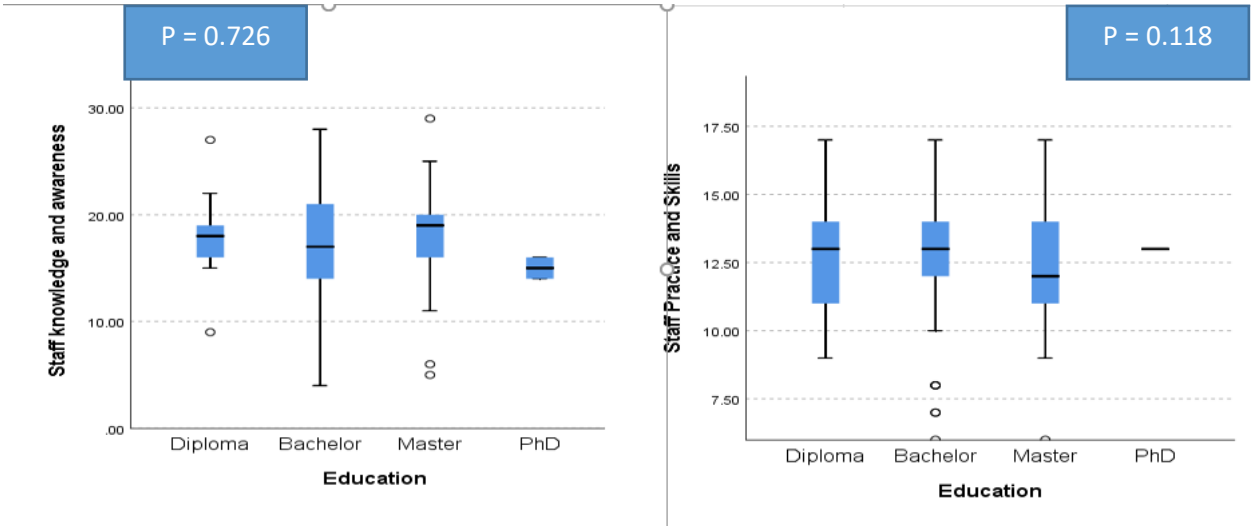

Figure 3 12 Distribution of SPCA & SPCB in relation to Level of Education

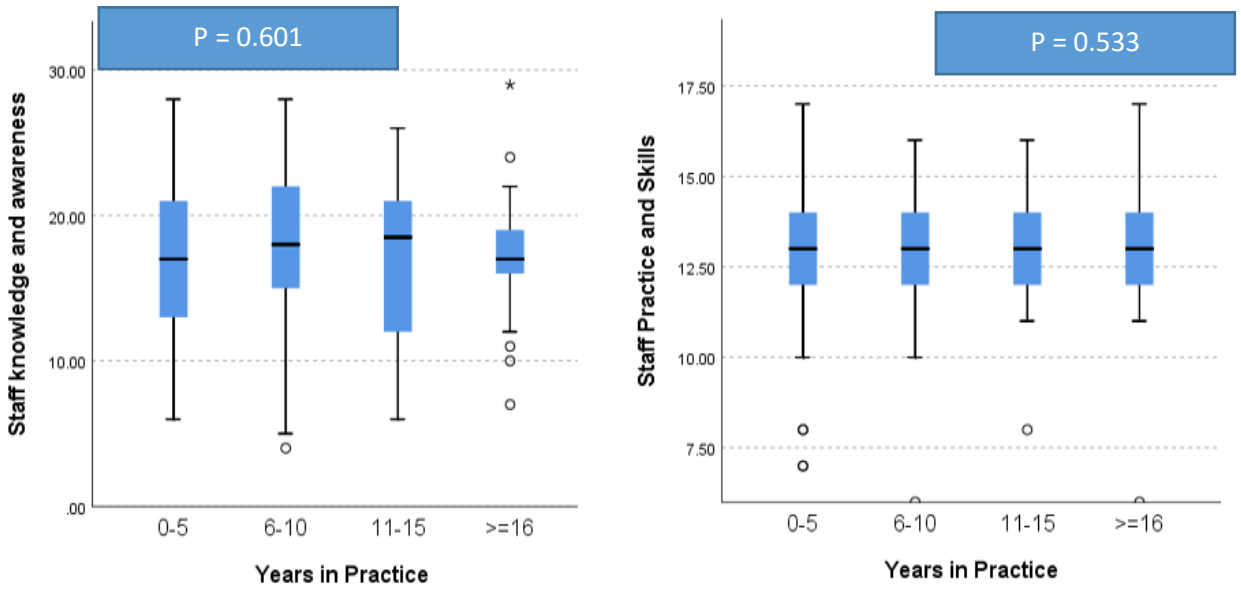

Figure 3 13 Distribution of SPCA & SPCB in relation to Years in Practice

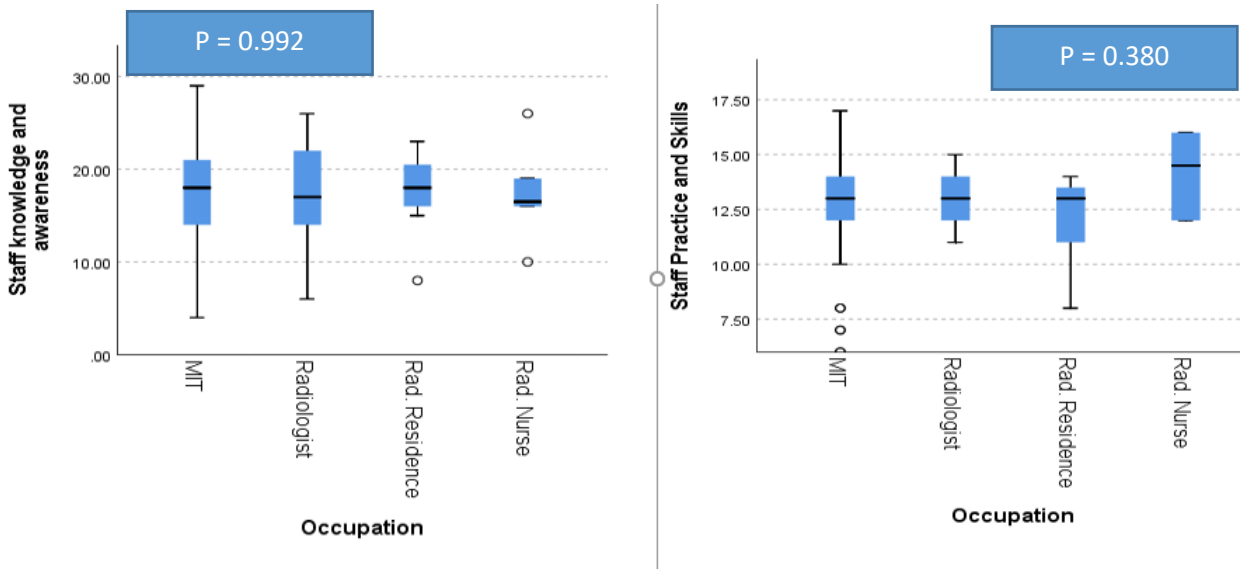

Figure 3 14 Distribution of SPCA & SPCB in relation to MIW's Occupation

Chapter 4: Discussion

COVID-19 has considered as a pandemic since March, 2020, because of its large morbidity and mortality rates all over the world. HCWs was and still at the first line fighting COVID-19 pandemic, which put them in a high risk of getting infected either by the virus itself or by its psychological effects e.g. depression, anxiety (Villalba-Arias, et al., 2020).

MIWs were also at the front line, because of the role of diagnostic imaging exams (mainly CXR & CT scan) in diagnosis and management of suspected and/ or confirmed patients with COVID-19.

Despite huge educational efforts that have been conducted at global and local levels, inadequate level of knowledge and practices of ICP guidelines were noted among HCWs in general and particularly among MIWs, this supported by large number of infected HCWs in Palestine (6116) (Ministry of Health, 2021) till the date of start writing this study in the last of September 2020, and 74 MIWs (36.9%) according to our results.

We conducted a cross-sectional study that aimed to assess the impact of COVID-19 pandemic on Palestinian MIWs; infection sources, awareness and commitment to relevant safety guidelines. 205 valid responses to our questionnaire were subjected to statistical analysis. 2 third of them were males and the majority of our sample was filled in the 20-30 years old group (102 (49.8%)), which means the older one of them is graduated only before less than 10 years and this explain the large number of targeted MIWs were 0-5 years in practice, 81.9% holding a bachelor degree.

85.4% of participants were MITs, 8.3% radiologists, 3.4% radiology residence and only 2.9% radiology nurse. Known that there is many procedures (biopsies, drains, contrast procedures and sensitive ultrasound exams e.g. breast ultrasound, done in diagnostic imaging departments which demands the availability of radiology nurse to monitor the patient's condition during the procedures (e.g. monitor vital signs, prepare for sterile procedures, administer medications, suction patient, insert foleys and help patients with their personnel needs), but unfortunately we found only 14 nurses in all 34 main hospitals in Palestine.

There was 36.1% of all targeted MIWs were had a previous positive COVID-19, which considered a high percentage in relation to total MIWs population in Palestine (about 500 MIWs), 61.6% of them due to nosocomial infection source. Unfortunately, we didn't find a study on infected MIWs but there is a study held in Helsinki University Hospital (HUS) in Finland were 866 participants HCWs completed a cross-sectional questionnaire, 41 (4.7%) of them were infected with COVID-19, of those were 22 (53.7%) due to confirmed and likely workplace (nosocomial), 4 (9.8%) unclear infection source and 15 (36.6%) were outside workplace (Oksanen, et al., 2021).

Also a study in Milan (Italy) on 172 HCWs all of them were had a positive COVID-19 result at the time of study, there was 50% and 10% due to contact with other HCWs and patients, respectively (Nosocomial), 29% unknown source of infection and 11% from family (social) (Mandić-Rajčević, et al., 2020). In Ontario, Canada, was aimed to describe and compare HCWs and non-HCWs COVID-19 cases as well as the frequency of COVID-19 among HCWs, this study population was 24202 confirmed COVID-19 cases in Ontario, as of 14 May, 2020, including 4230 (17.5%) HCWs, 108 (3.1%) of them due to nosocomial infection and the majority 2718 (76.9%) were missed or due to unknown infection source (Schwartz, et al., 2020).

In Fars, Iran, a study on 273 infected HCWs, from 10 March to 17 May 2020 due to occupational source, 15 (5.5%) were from radiology department (Sabetian, et al., 2021).

79.2% of all participants reported that their organization (Hospital) is an authorized facility for COVID-19 patients, of them there was 75.2% in governmental sector, 83.6% and 83.8% in private and NGOs sectors, respectively. In Libya, a study was conducted among HCWs (Doctors and nurses) working in emergency, ICU and infectious diseases departments in 21 hospitals, among 1572 HCWs, only about 13.4 % of them report that their hospital was prepared for COVID-19 pandemic (Elhadi, et al., 2020).

A statistical significance ($P < 0.001$) were noted in our study between health care sectors related to participant's confidence in hospital preparedness for COVID-19, the least confidence level was among governmental sector (50.5%), while in NGOs sector (89.2%) and private sector (70.9%), this is a very good result comparing to the previous study held in Libya , where only14.8% of all participants report that they confidence and highly confidence, but the majority of them (50%) have no confidence in management of COVID-19 patients (Elhadi, et al., 2020).

In Menoufia University isolation unit during the period from June 10th- August 10th, 2020, a researchers conducted a study on 206 HCWs, 91.7% of them were feel safe in their work environment against COVID-19, this is supported by a low infected rate among targeted HCWs (5.8%, 12 out of 206 HCWs was infected) (Ghonaim, et al., 2021).

As medical care has become more complex and patients have become more complicated, Health Care Associated Infections (HAIs) have become more common. HAIs cause significant morbidity, mortality and financial costs (Chen, Chou, & Chou, 2016). Growing HAI rates, combined with evidence that active surveillance and infection control practices can help HAIs, prompted the development of hospital epidemiology and infection control programs. The role of infection control programs has grown and continues to grow as antimicrobial resistance rates rise and HAIs increase patient risks and health-care costs (Sydnor & Peri, 2020).

CDC defines HAIs as infections acquired while in a health care setting (e.g. inpatient hospital admission, hemodialysis unit or day care surgery), with no evidence that the infection was present at the time of entry into the health care setting (Horan, Andrus, & Dudeck, 2008). Infection control programs is now mandatory to reduce the rate of HAIs and their effects on health care system (Haley, et al., 1985).

With no significant association between the three health care sectors, 78.6% of participants in our study revealed that there is an infection control department in their work place. Even in private sector there was about 71% of participants reported the extent of infection control department, this is understandable given that the private sector's primary goal is profit, or at least the avoidance of expenses that are deemed unnecessary. However, Palestinian ministry of health should have a greater oversight role overall health care sectors in order to ensure society's overall safety.

During the pandemic, infection control and PPE were and continue to be major sources of concern on a national and international scale. Precautions to limit contamination between patients and/or other professionals in the management of suspected or confirmed COVID-19 patients, including strict adherence to a PPE protocol, are strongly advocated in patient-facing environments, such as radiology departments (Mossa-Basha, et al., 2020). Respondents in this study claimed that their hospital provided enough PPE for work during the COVID-19 pandemic with a total rating of 89.1 %. Participants in the survey from the government sector were less concerned (84%) than those from other sectors regarding the availability of PPE.

A group of researchers conducted a study aimed to investigate the response of the Radiology Work Force (RWF) to the impact of COVID-19 pandemic on professional practice in India and eight other Middle Eastern and North African countries, there were 903 responses, 79.5% of them strongly agreed or agreed that PPE was adequately available at work during the pandemic (Elshami, et al., 2021).

While a study held in UK on 522 RWF, fear of contracting the infection as well as perceived inadequacy of PPE (only half 50.4% of the respondents agreed that there were adequate PPE available during the study period) were identified as major stressors during the study period (Akudjedu, et al., 2020).

One of the positive findings in this study was that 89.1% of participants said that; nurse or doctor informed them about the patient's condition (whether he was suspected or confirmed case of COVID-19) before sending him to imaging department.

Social distancing is an essential factor in containment of COVID-19 pandemic (Ashari, Zainal, & Zaki, 2020). Thus, rescheduling elective appointments is an important step to raise the

preparedness of the institution in facing COVID-19 pandemic, also to focus on urgent and emergency cases. Fortunately, 97% of our study's respondents revealed that their institution and/or department had reschedule elective appointments.

It is also noted in study's findings that there is almost complete satisfaction (90.1%) with the level of communication by the administration among MIWs in all health sectors, even if workers in the NGOs sector are more satisfied (96.6%), there is no significant difference from the rest of sectors, whether in terms of examination or treatment, or arranging quarantine of the staff that exposed to the virus.

Significant association (P =0.001) between health care sector related to the feel of the staff in capability of their department to deal with COVID-19 patients, as MIWs in the NGOs sector are more confident (88.9%) than others that their departments are prepared to handle COVID-19 patients. This is consistent with the above-mentioned findings in terms of MIW's satisfaction in NGOs sector in terms of hospital's preparedness, availability of an infection control department, coordination between diagnostic imaging department and others hospital's department before sending suspected/confirmed COVID-19 case, and level of communication with MIWs in case of exposure to COVID-19 virus.

About half of participants in all sectors (Governmental (49.1%), Private (52.7%), and NGOs (56.8%)) revealed that there is a representative person for infection control department in diagnostic imaging department. Although the results showed that the presence of an infection department's representative in diagnostic imaging department had no effect on MIWs knowledge and awareness (P=0.175), it did have an effect on the level of staff skills and practices of infection control methods (P=0.028).

Diagnostic imaging departments in the NGOs sector had policies, strategies, and developed standard procedures, according to 90.3% of participants, compared to 71.6% in the government sector.

More than half of all participants (125/205, 63.8%) revealed that the work-load had increased during the pandemic, which means more exposure of MIWs to the corona virus and also increase the risk of infection. It is a very close to the results of a study conducted in UK, where 64.2% of 522 participants agreed (strongly agree (196) and agree (139)) that their work-load had increased during the pandemic (Ashari, Zainal, & Zaki, 2020).

Rapid responses in diagnostic imaging departments were required due to COVID-19 pandemic e.g. work from home for radiologist or change the shift mode for MITs as a steps to manage and safe work forces, our results have no significance association between all sectors in relation of these steps, while the governmental sector's participants, 81.1% revealed that their shifts modes

had changed during pandemic with no much difference from other sectors (Private 75%, NGOs 75.9%).

Significant differences (P= 0.033) were noted between health care sectors in the participant's revelations about the readily accessible of supplies necessary to hand hygiene in department, with 100% of responses in the private sector compared to 94.4% in NGOs and 86.5% in governmental, and this is considered one of a good responses from private sectors to the increase of work load (mentioned above), as it is known that hand hygiene should be between each patient and when supplies were more close to staff; hand hygiene be more.

Allocate a separate x-ray room, x-ray machine or a separate ultrasound room is a valuable step to decrease cross infection between patients and/or staff, there were 53.8% in governmental sector reported that their department allocate a separate x-ray room comparing to 27.6% in NGOs while for a separate ultrasound room there were 52.9% responded "YES" in NGOs compared to 35.6% in governmental.

100% of participants in NGOs sector reported that they clean all radiological equipment and accessories on a routine basis, this may be due to hospital and department preparedness (HEP & DEP) were better than in governmental or private sectors.

Staff training is necessary to avoid disease transmission in hospital and to provide continual professional development in preparation for future pandemics. In this study, only 29% of participants in the government sector received explicit guidance and training for dealing with suspected/infected COVID-19 patients, which is a very low rate when compared to 57.6% and 59.6% in the NGOs and private sector, respectively.

Also, Akudjedu et al in their study held in UK reported that 48.3% of respondents had training on handling COVID-19 patients (Akudjedu, et al., 2020). W. Elshami et al in their study on RWF, found that only 58% of RWF had received training on infection control for handling COVID-19 patients (Elshami, et al., 2021).

The main mechanism of transmission for the COVID-19 has been established as human-to-human transfer via droplets and contact (Ashari, Zainal, & Zaki, 2020). About their knowledge of the way that SARS-CoV-2 transmit, 30.3% of participants revealed it is by airborne, 33.8% via droplet, 34.3% via contact and 12.4% don't know the transmission mode. These results are very low compared to an Indian study on medical imaging professionals MIPs, were 98% of participants answered correctly about the transmission mode of SARS-CoV-2 (Kotian, Faujdar, Kotian, & D'souza, 2020) and low also compared to Elshami et al study were 93.6% of respondents understood the mode of coronavirus transmission.

Pathogens can be reduced or eliminated using disinfection techniques. To avoid infection transmission, RWFs should be aware of the importance of sanitizing contact surfaces between patients (Hubble et al., 2016). Majority of our study participants (88.4%) reported that they have knowledge about types of disinfectants and how to prepare them. This is similar to study held in Sudan among radiology staff were 90% of respondents reported that the disinfectant should be used after contact with every suspected/confirmed COVID-19 patients (Elgyoum et al., 2020). While in a study among health care workers in radiology departments in Saudi Arabia, there were 67.2% of participants have knowledge about the types of disinfectants and how to prepare them (Aljondi, et al., 2021).

More than half (58.7%) of all participants reported that their source of information about COVID-19 was due to their self-reading, while only 4% of them revealed that university curriculum is the source of information. Despite the fact that more than one epidemic has swept the globe since the beginning of the twenty-first century, the university's involvement in teaching ways of prevention and protection from infectious diseases is regrettably limited.

In the health-care setting, hand hygiene serves a variety of reasons (WHO, 2009). It protects patients from both endogenous and exogenous diseases, as well as potential pathogen contamination of the hospital environment and cross-transmission of microorganisms between patients. It also protects health care professionals from nosocomial infections when used in conjunction with the necessary protective equipment (Longtin, Sax, Allegranzi, Schneider, & Pittet, 2011).

Hand rubbing with an alcohol-based hand-rub formulation and hand washing with soap and water are two well-known methods for practicing hand hygiene (Longtin, Sax, Allegranzi, Schneider, & Pittet, 2011).

Our findings revealed that 32.8% said hand washing with soap and water is a form of hand hygiene, 13.4% said antiseptic hand wash is a form of hand hygiene, 24.8% said antiseptic hand rub is a form of hand hygiene, and 39.1% said any of these three techniques is a form of hand hygiene. These findings could indicate that MIWs have a limited understanding of infection prevention strategies, as hand hygiene is one of the most critical methods for avoiding infections. Although, majority of participants know that wearing gloves doesn’t replace the need for hand hygiene.

While the results of a study conducted at District 2 Hospital in Ho Chi Minh City on 327 HCWs, revealed that 92.7% of participants considered washing hands with soap frequently can prevent transmission of COVID-19 (Huynh, et al., 2020).

According to occupational safety and health administration in United States and CDC, HCWs who exposed to suspected or confirmed COVID-19 patient should wear; Gloves, Gowns, Eye/Face protection (e.g. goggles, face shield), and disposable N95 or better (OSHA, 2020) (COVID-19, 2020).

Despite the fact that China is a significant provider of PPE, COVID-19 caused a critical shortage of PPE. In 2017, the Chinese National Health Commission issued technical guidance for the control of airborne transmission diseases in healthcare facilities, with three levels of personal protection, which was updated in February 2020 for the prevention of the spread of COVID-19, where, level 1 is a minimum requirement includes; disposable caps, surgical masks, white coats, and hand hygiene, needed for HCWs working in routine patients care e.g. outpatient clinic or ER, Level 2 is for requirements for HCWs working with suspected and/or confirmed COVID-19 patients, includes; In addition to PPE for Level 1 protection, goggles and full-face shields, long sleeved, fluid repellent gowns, and shoe covers are used. And level 3 for HCWs who perform aerosol-generating procedures or handle bio-samples from infected patients, includes; full face shields, eye protection, FFP masks, gloves, and fluid repellent sleeved gowns (livingston, Desai, & Berkwits, 2020) (Hou, et al., 2020).

Zanardo et al. submitted a technical note based on WHO standards and done on behalf of the Italian Federation of Radiographer Scientific Societies to provide a detailed evaluation of different approaches used on management of suspected or confirmed COVID-19 patients, protection level for HCWs was one of these approaches, "recommended types of PPE according to this technical note were as follows (Zanardo, et al., 2020);

- Minimum requirements include: disposable surgical masks, surgical caps and disposable gloves.
- Suspected COVID-19 case: disposable surgical masks, disposable surgical caps, eye protection (goggles or visor), protective clothing or insulating outer gown, disposable gloves and disposable shoe covers. At the end of the sanitization procedure, it is essential to wash hands and to rigorously apply a sanitizing gel.
- Confirmed COVID-19 case: disposable surgical masks, disposable surgical caps, eye protection (goggles or visor), protective clothing or insulating outer gown, disposable gloves and disposable shoe covers. If aerosol-generating procedures performed on COVID-19 patients, respirator such as N95/99 or FFP2/3 are required. At the end of the sanitization procedure, it is essential to wash hands and to rigorously apply a sanitizing gel." (Zanardo, et al., 2020)

.

In our study, we asked participants about the minimum level of protection required, as well as the level of protection required when dealing with a suspected and/or confirmed COVID-19 patient. Our findings showed a lack of knowledge among MIWs, as their responses revealed that they do not know the exact PPE for each level.

Around the half (48.9%) of all participants in all health care sectors, answer correctly to the minimum requirement protection level. And about 57.4% of them answered correctly about the level of protection for suspected COVID-19 patient. 77.2% of them answered correctly about the level of protection when dealing with confirmed COVID-19 patient, the NGOs respondents were the most rate 83.5%.

These findings may reflect a lack or low level of awareness and knowledge about infection prevention policies, as well as the fact that MIWs in NGOs sector responded at a higher rate than MIWs in other sectors, possibly because they also reported having an infection control department and policies and guidelines. Furthermore, more than half of them said they had received training in dealing with suspected/confirmed COVID-19 patients.

Infection control strategies in hospitals believe hand hygiene to be the cornerstone. It's a challenging task to modify people's hand hygiene behaviors, and numerous factors play a role; Staff shortages and overcrowding are the most significant negative aspects, as are a lack of hand hygiene products (soap, alcohol-based solutions, paper towels, and so on), an inadequate knowledge about hand hygiene, a lack of institutional priority given to hand hygiene, and a lack of role models for good hand hygiene (Alp, et al., 2011). PPE is also an important part of infection control techniques for protecting HCWs because it is designed to prevent infections in the particular HCW as well as secondary spreading to other HCWs and patients (Reddy et al., 2019).

According to our findings, 76.1% and 67.3% of people had received instruction in hand hygiene and PPE use, respectively. There is a significant distinction between the health-care sectors. Where NGOs provided a high percentage of training on hand hygiene and PPE use, the government should expand its educational and training programs for employees. This is similar to the findings of Elgyoum et al study, is Sudan, where 65% of MIWs reported that they had training on hand hygiene, and 75% of them had knowledge about hand hygiene (Elgyoum et al., 2020).

Regarding the fact that these results are better than those reported in Elhadi et al study, in Libya, were only 54.3% of overall participants showed that they were prepared to utilize PPE properly (Elhadi, et al., 2020).

Ghonaim et al study revealed that HCWs showed a high level of awareness and a positive attitude regarding the importance of proper PPE donning, doffing, and off training. When dealing with confirmed cases, healthcare staff expressed a strong positive attitude regarding the need of having PPE on available (Ghonaim, et al., 2021).

Our participants had a low level of knowledge about infection control practices, whereas a study conducted among MITs in Jordan about their knowledge of nosocomial infection control

practices revealed moderate knowledge in infection control practices, implying that the MITs' information about infection control practices is inconsistent with the scientific literature and thus deficient (Abdelrahman, et al., 2017). Good practice of hand hygiene before and after putting/removing gloves, changing surgical mask daily and covering cassettes and grids with a disposable, clear plastic cover.

Chapter 5: Conclusion and Recommendations

Findings among Palestinian MIWs revealed a moderate level of confidence in hospital preparedness and diagnostic imaging department capability in dealing with suspected or confirmed COVID-19 patients, absence of an ICP representative in diagnostic imaging department, poor training on handling COVID-19 patients, a low level of hand hygiene practice even the majority reported that they had training on hand hygiene, lack of knowledge and training on proper PPE use and lack of understanding about COVID-19 transmission mode. These may explain a high infected rate (36.1%) due to a nosocomial source in the majority of cases (61.6%) among MIWs.

In addition, the data revealed that self-reading was the most common source of information for MIWs, with little in-hospital training and a near-complete lack of external training and university curricula. However, when dealing with suspected or confirmed COVID-19 patients, gender, age, education level, years in practice, and occupation were not major indicators of staff knowledge and practice of ICP.

HEP, DEP, and SPCA were consistent across all sectors, whereas SPCB differed marginally. The governmental sector had the lowest level of MIW confidence. As a result, our findings emphasize the vital need of expanded COVID-19 pandemic training for MIWs, as well as related protective measures.

Finally, these are some recommendations to elevate the level of MIWs knowledge and practices towards COVID-19 or any other infected pandemic in future;

1. The infection control department's role should be expanded in terms of providing continuous education and training to hospital employees, and there should be a representative of it in every department of the hospital, including the diagnostic imaging department, to aid in task distribution and maintain a greater level of control over the level of knowledge and practice of all medical staff in each department, and this role is entrusted first to the Ministry of Health (MOH) then to the hospital administration.
2. Infection control and prevention course, should be included in medical imaging faculties' study plans, and it should be a mandatory requirement for medical imaging students.

Appendix 1: Ethical Approval

Al-Quds University
Jerusalem
Deanship of Scientific Research

بسم الله الرحمن الرحيم

جامعة القدس
القدس
عمادة البحث العلمي

Research Ethics Committee
Committee's Decision Letter

Date: June 02, 2021
Ref No: 190/REC/2021

Dears Dr. Mohammad Hjouj, Mr. AbdulKarim Dahdolan,

Thank you for submitting your application for research ethics approval. After reviewing your application entitled "Radiology Staff knowledge, awareness and practice towards COVID-19 pandemic in hospitals of Palestine: A Cross-sectional Descriptive Study", the Research Ethics Committee confirms that your application is in accordance with the research ethics guidelines at Al-Quds University.
We would appreciate receiving a copy of your final research report/ publication.

Thank you again and wish you a productive research that serves the best interests of your subjects.

PS: This letter will be valid for two years.

Sincerely,

Suheir Ereqat, PhD
Associate Professor of Molecular Biology

Research Ethics Committee Chair

Cc. Prof. Imad Abu Kishek - President
Cc. Members of the committee
Cc. file

Abu-Dies, Jerusalem P.O.Box 20002
Tel-Fax: #970-02-2791293
research@admin.alquds.edu
أبوديس، القدس ص.ب. 20002
تلفاكس: #970-02-2791293

Appendix 2 Questionnaire and Consent Form

نموذج الموافقة على تعبئة إستبيان

عنوان البحث:

Radiology Staff knowledge, awareness and practice towards COVID-19 pandemic in hospitals of Palestine: A Cross-sectional Descriptive Study.

اسم الباحث: عبد الكريم خليل دحدولان

نشكرك على موافقتك على تعبئة هذا الاستبيان كجزء من مشروع البحث أعلاه! يستغرق الاستبيان عشرة دقائق.

نموذج الموافقة هذا ضروري بالنسبة لنا للتأكد من أنك تفهم الغرض من الدراسة وأنك توافق على شروط مشاركتك.

لديك الحق في عدم تعبئة الاستبيان أو الانسحاب من البحث في أي وقت.لذلك ، الرجاء قراءة ورقة المعلومات:

1. سيقتصر الوصول إلى الاستبيان على الباحث/ الباحثين الموقعين أدناه لضمان الخصوصية والسرية.
2. من أجل الحفاظ على السرية الخاصة بك، سيتم إخفاء هويتك او اي معلومات شخصية.
3. الاستبيان سيتم حفظه في مكتب الدكتور محمد حجوج –جامعة القدس–، المشرف على الباحث.

من خلال توقيعي على هذا النموذج أوافق على:

1. أنا أشارك طواعية في هذا المشروع.
2. يمكن نشر نتائج البحث في أوراق أكاديمية أو عروض تقديمية / موقع جامعي دون أي شيء يمكن من التعرف عليّ.
3. لقد قرأت المعلومات المذكورة أعلاه.
4. لا أتوقع أن أحصل على أي فائدة أو مدفوعات مقابل مشاركتي.
5. لقد تمكنت من طرح أي أسئلة وأفهم أنه يمكنني الاتصال بالباحث/ الباحثين لأي سؤال قد يكون لدي.
6. أفهم أن أي تغيير للشروط المذكورة أعلاه لن يحدث إلا بموافقتي الصريحة.

معلومات الاتصال:

تمت مراجعة هذا البحث والمصادقة عليه من قبل لجنة أخلاقيات البحث في جامعة القدس. إذا كانت لديك أي أسئلة أو مخاوف أخرى بشأن هذه الدراسة ، فيرجى الاتصال بـ:

اسم الباحث: عبد الكريم خليل دحدولان

العنوان الكامل: القدس – ابو ديس

الهاتف: 0592726439 // 0523752729

بريد الالكتروني: dabdelkarim@gmail.com

الزميلات والزملاء الأعزاء،

تحية طيبة وبعد: -

مما لا شك فيه أن جائحة كورونا (COVID-19)، أثّرت بشكل كبير على كل مناحي الحياة في العالم بشكل عام، وعلى الحياة في فلسطين بشكل خاص، فقد اضافت هذه الجائحة تحديا وعبئا جديدا، اضافة إلى التحديات الموجودة قبلها، وعلى رأسها الاحتلال وشح الموارد. وكان للنظام الصحي في فلسطين كما في كل العالم النصيب الأكبر من هذا التحدي، وما زلنا نعاني منذ أكثر من عام من هذا التأثير في كافة الأقسام الطبية وعلى رأسها المستشفيات بأقسامها المختلفة.

في هذه الدراسة سيقوم الباحث من طلاب جامعة القدس- كلية الدراسات العليا – برنامج ماجستير تكنولوجيا التصوير الطبي (الفرع الوظيفي)، بتسليط الضوء على أحد أهم الأقسام الطبية التي كان لها دور كبير في فرز وتشخيص الحالات المصابة، وهو قسم الأشعة والتصوير الطبي، عن طريق تصوير الصدر سواء بالأشعة العادية (Chest Radiography) او بالأشعة المقطعية (Chest CT)، حيث أن هناك دراسات قدّرت فعالية ال (CXR) ب 56-69 % و (Chest CT) ب اكثر من 95% في قدرة كل منهما على الكشف السريع عن الحالات المصابة، خاصة وأن فحص ال PCR يستغرق وقت طويل.

هدف الدراسة هو دراسة مدى **الوعي والمعرفة وممارسة اساليب الوقاية من العدوى لدى العاملين في أقسام الأشعة في المستشفيات الفلسطينية (Radiology Staff Knowledge & Awareness towards COVID-19 pandemic in Hospitals of Palestine).**

الاستبيان المرفق يستغرق عشرة دقائق، نرجو منكم تعبئته بشكل حيادي في سبيل البحث العلمي وإثراء المعرفة ومحاولة استكشاف الواقع الحقيقي لأقسام الأشعة والتصوير الطبي في فلسطين فيما يخص أساليب الوقاية من العدوى.

ونؤكد لكافة الزملاء والزميلات على التزامنا بالسرية وأن هذا الاستبيان سيتم استعماله لأغراض البحث العلمي فقط.

وتقبلوا فائق الاحترام والتقدير

الباحث: عبد الكريم دحدولان \ دائرة التصوير الطبي \ كلية المهن الصحية – جامعة القدس \ القدس

للاستفسار يرجى الاتصال على: 0592726439 او 0523752729

او عن طريق إيميل: dabdelkarim@gmail.com

Gender	Male	Female		
Age	20-30	31-40	41-50	≥ 51
Education	Diploma	Bachelor	Master	PhD
Years in Practice	0-5	6-10	11-15	≥16
Occupation	Medical Imaging Technologist (MIT)	Radiologist	Rad. Residence	Rad. Nurse
Radiology Subunit	Routine & Flouro	CT	MRI	U/S
Hospital Sector	Governmental Hospital	Private Hospital	NGOs	
Do you had a previous COVID-19 positive result	Yes	No		
If "YES" where did you get the infection from?	Nosocomial (hospital)	Home	Social Activity	Don't know

1. هل المستشفى التي تعمل بها، معتمدة لاستقبال مرضى COVID-19؟ ☐ نعم ☐ لا
2. هل أنت واثق من استعداد المستشفى لـ COVID-19؟ ☐ نعم ☐ لا
3. في مكان عملك ، هل يوجد قسم لمكافحة العدوى؟ ☐ نعم ☐ لا
4. أتاح المستشفى كميات من المعدات الخاصة بالحماية الشخصية المناسبة للعمل أثناء تفشي COVID-19 .

☐ موافق بشدة ☐ موافق ☐ محايد ☐ غير موافق ☐ غير موافق بشدة

5. قبل إرسال المريض إليك من الفرز أو غرفة الطوارئ أو القسم ، هل يتم ابلاغك من قِبل الممرضة أو الطبيب فيما إذا كان المريض حالة مشتبه أو مؤكد إصابته ب COVID-19؟

☐ دائمًا ☐ غالبًا ☐ أحيانًا ☐ نادرًا ☐ أبدًا

6. لرفع جهوزية المستشفى ، يجب إعادة جدولة المواعيد الاختيارية(غير الطارئة) للتركيز على الحالات العاجلة والطارئة.

☐ موافق بشدة ☐ موافق ☐ محايد ☐ غير موافق ☐ غير موافق بشدة

7. كان هناك تواصل مع خدمات الرعاية الصحية المهنية للاختبار والعلاج والحجر الصحي، للموظفين الذين تعرضوا للفيروس سواء من بيئة الرعاية الصحية أو المجتمع.

☐ موافق بشدة ☐ موافق ☐ محايد ☐ غير موافق ☐ غير موافق بشدة

8. هل قسم الأشعة والتصوير الطبي لديكم مؤهل للتعامل مع مرضى Covid-19 ؟ ☐ نعم ☐ لا ☐ لا أعرف
9. هل يوجد مندوب او ممثل عن قسم مكافحة العدوى في قسم الأشعة والتصوير الطبي؟ ☐ نعم ☐ لا
10. لدينا سياسات واستراتيجيات للإدارة وإجراءات معيارية مطورة بناءً على إرشادات محلية ووطنية ودولية.

☐ موافق بشدة ☐ موافق ☐ محايد ☐ غير موافق ☐ غير موافق بشدة

11. أي مما يلي يصف بشكل أفضل عبء العمل بعد جائحة COVID-19؟

☐متزايد ☐ متناقص ☐ لا تغيير لا أعرف

12. تم ترتيب العمل من المنزل لأخصائيي الأشعة (توفير workstation and utilizing video conferencing software for meetings) من أجل تقليل الفريق في القسم إلى قوة العمل الآمنة.

☐ موافق بشدة ☐ موافق ☐ محايد ☐ غير موافق ☐ غير موافق بشدة

13. بسبب الوباء ، تغير وضع الورديات الخاص بك ، كخطوة لإدارة القوى العاملة في القسم.

☐ موافق بشدة ☐ موافق ☐ محايد ☐ غير موافق ☐ غير موافق بشدة

14. المستلزمات او المواد اللازمة للالتزام بنظافة اليدين، يمكن الوصول إليها بسهولة في القسم.

☐ دائمًا ☐ غالبًا ☐ أحيانًا ☐ نادرًا ☐ أبدًا

15. . بعد ظهور الوباء ، تم تخصيص غرفة منفصلة للأشعة السينية لمرضى COVID-19 المشتبه بهم / المؤكدين.

☐ موافق بشدة ☐ موافق ☐ محايد ☐ غير موافق ☐ غير موافق بشدة

16. بعد ظهور الوباء ، تم تخصيص جهاز أشعة متنقل لتصوير المرضى المشتبه او المؤكد اصابتهم ب COVID-19 داخل اقسام المستشفى.

☐ موافق بشدة ☐ موافق ☐ محايد ☐ غير موافق ☐ غير موافق بشدة

17. بعد ظهور الوباء، تم تخصيص جهاز تصوير تلفزيوني لتصوير المرضى المشتبه او المؤكد اصابتهم ب Covid-19 .

☐ موافق بشدة ☐ موافق ☐ محايد ☐ غير موافق ☐ غير موافق بشدة

18. . نقوم بتنظيف جميع الأجهزة وملحقاتها على أساس روتيني (على سبيل المثال أسبوعيًا) ، سواء كانت متسخة أو غير متسخة.

☐ دائمًا ☐ غالبًا ☐ أحيانًا ☐ نادرًا ☐ أبدًا

19. هل كانت هناك طريقة مدعومة من قبل المستشفى للتخلص من النفايات المتعلقة بالبدلات والمعدات الواقية الملوثة أثناء وباء COVID-19 في أقسام الأشعة؟ ☐ نعم ☐ لا

20. هل تلقيت أي تدريب للتعامل مع المرضى المشتبه في إصابتهم بفيروس COVID-19؟ ☐ نعم ☐ لا

21. ينتقل فايروس Covid-19 عن طريق :-

☐ Airborne ☐ Droplet ☐ Contact ☐ I do not know

22. لدي معرفة بالاحتياطات المطلوبة عند التعامل مع حالات COVID-19 المشتبه بها / المؤكدة.

☐ موافق بشدة ☐ موافق ☐ محايد ☐ غير موافق ☐ غير موافق بشدة

23. لدي معرفة بأنواع المعقمات (المطهرات) وكيفية تحضيرها واستخدامها.

☐ موافق بشدة ☐ موافق ☐ محايد ☐ غير موافق ☐ غير موافق بشدة

24. مصدر المعلومات الخاصة بك حول مكافحة العدوى والوقاية منها:

☒ قراءة ذاتية ☐ تدريب داخل المستشفى ☐ تدريب خارج المستشفى ☐ منهاج الجامعة

25. نظافة (تعقيم) اليدين تعني تنظيف اليدين باستخدام:

☐ غسل اليدين بالماء والصابون.

☐ غسل اليدين باستعمال المعقّم (المطهر antiseptic)

☐ مطهر لليدين (مثل معقم اليدين المحتوي على الكحول بما في ذلك الرغوة أو الجل) ، أو مطهر اليد الجراحي.

☐ اي واحدة مما سبق.

26. ارتداء القفازات لا يحل محل الحاجة إلى نظافة (تعقيم) اليدين: ☐ صحيح ☐ خطأ ☐ لا أعرف

27. بالنسبة لحالات COVID-19 المؤكدة أو المشتبه فيها ، يُفضل إستخدام جهاز التراساوند متنقل عند الحاجة لاجراء تصوير تلفزيوني لها.

☐ موافق بشدة ☐ موافق ☐ محايد ☐ غير موافق ☐ غير موافق بشدة

28. اختر مستوى الحماية المطلوب لمقدمي الرعاية الصحية حسب الحالة المحددة:

	Surgical mask	Surgical caps	Gloves	Eye protection (goggles or face shield)	Shoe covers	Gown	Medical mask N95/99 or FFP2/3
الحد الأدنى من المتطلبات							
حالة مشتبه بإصابتها ب Covid-19							
حالة مؤكد إصابتها ب Covid-19							

29. لقد تدربت بالفعل على:

- نظافة اليدين. ☐ نعم ☐ لا
- الاستخدام الصحيح لمعدات الحماية الشخصية (تسلسل الارتداء والخلع لل PPE) . ☐ نعم ☐ لا

30. من أجل تجنب الإصابة بفيروس COVID-19 أو الوقاية منه ، يجب عليك ممارسة ما يلي:

- يمكن للمرضى الذين يعانون من السعال الشديد الانتظار في منطقة الانتظار. ☐ نعم ☐ لا ☐ لا أعرف
- يجب عدم تنظيف السوائل المنسكبة بالجسم وتركها لعامل النظافة في جميع الأوقات. ☐ نعم ☐ لا ☐ لا أعرف
- يمكن استخدام الأحواض (المغاسل) للتخلص من إفرازات المريض. ☐ نعم ☐ لا ☐ لا أعرف
- يجب تغطية جميع المثبتات الإسفنجية والمخدات بغلاف (بلاستيك ، ورق ، ... إلخ) ، ويجب تغيير الغلاف بين كل مريض.
  ☐ نعم ☐ لا ☐ لا أعرف
- يجب تنظيف طاولة التصوير بعد كل فحص. ☐ نعم ☐ لا ☐ لا أعرف
- هل تطلب من المريض أو من مرافقه لبس الكمامة قبل الدخول الى القسم؟
  ☐ دائمًا ☐ غالبًا ☐ أحيانًا ☐ نادرًا ☐ أبدًا

31. قبل ارتداء القفازات، اقوم بغسل يديّ او تعقيمهما بالكحول.
☐ دائمًا ☐ غالبًا ☐ أحيانًا ☐ نادرًا ☐ أبدًا

32. بعد خلع القفازات، اقوم بغسل يديّ او تعقيمهما بالكحول.
☐ دائمًا ☐ غالبًا ☐ أحيانًا ☐ نادرًا ☐ أبدًا

33. اقوم بتغيير الكمامة بشكل يومي:
☐ دائمًا ☐ غالبًا ☐ أحيانًا ☐ نادرًا ☐ أبدًا

34. بالنسبة لفحوصات الموجات فوق الصوتية ، اقوم بتغطية ال Probe لجميع المرضى إن أمكن ؛ وأعمل التطهير المناسب لجهاز U / S وسرير الفحص بعد كل مريض.
☐ دائمًا ☐ غالبًا ☐ أحيانًا ☐ نادرًا ☐ أبدًا

35. التصوير المقطعي (CT scan) للمرضى المشتبه او المؤكد اصابتهم ب Covid-19، يجب تأجيلهم لآخر الشيفت لتقليل عدد الأشخاص المخالطين للمريض.
☐ موافق بشدة ☐ موافق ☐ محايد ☐ غير موافق ☐ غير موافق بشدة

36. يقوم اثنان من تقنيي التصوير الطبي بإجراء الأشعة المقطعية (أحدهما في غرفة التحكم والآخر داخل وخارج غرفة التصوير).
☐ موافق بشدة ☐ موافق ☐ محايد ☐ غير موافق ☐ غير موافق بشدة

37. يجب أن يستخدم اخصائيو الأشعة وتقنيو التصوير الطبي نظامي PACS و RIS (Paper-Less) لتقليل الاحتكاك بالمرضى وغيرهم من موظفي المستشفى.

☐ موافق بشدة ☐ موافق ☐ محايد ☐ غير موافق ☐ غير موافق بشدة

38. يتم تغطية الكاسيتات بغطاء بلاستيكي لمنع التلوث ونقل العدوى بين المرضى.

☐ دائمًا ☐ غالبًا ☐ أحيانًا ☐ نادرًا ☐ أبدًا

39. اقوم بتنظيف طاولة الفحص (سواء فحص بالاشعة السينية، او المقطعية، او فحص تلفزيوني) بين كل مريض والآخر، وكذلك تنظيف اي شيء تعرض له المريض او لمسه.

☐ دائمًا ☐ غالبًا ☐ أحيانًا ☐ نادرًا ☐ أبدًا

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ملخص الدراسة

مقدمة: يُعتبر مرض كورونا (كوفيد-19) هو مرضا معدياً، يُسببه أحد الفايروسات التاجية والذي يُدعى بِـ (SARS-Cov-2)، ظهر لأول مرة في شهر كانون الأول من العام 2019، يعاني معظم الأشخاص اللذين يصابون بمرض كوفيد – 19 أعراضا خفيفة أو متوسطة ويتعافون من دون علاج خاص، ولكن في بعض الحالات تتفاقم الأعراض وحينها يتطلب رعاية طبية. لعب قسم التصوير الطبي دورا مهماً في تشخيص حالات الاصابة بفايروس كورونا بشكلٍ مبكر، لذا كان من الضروري الإلمام بأساليب الوقاية والحماية الشخصية من الأمراض المعدية لدى العاملين في أقسام التصوير الطبي، من أجل تجنب الإصابة بالعدوى وكذلك تجنب المساهمة في نقلها للآخرين.

أهداف الدراسة: هدفت هذه الدراسة الى تقيّيم تأثير جائحة كورونا على العاملين في أقسام التصوير الطبي من حيث مصادر العدوى ومدى الوعي والإلتزام بإرشادات السلامة والوقاية.

طريقة البحث: تم إجراء دراسة وصفية مقطعية في الفترة من 15 تموز ولغاية 15 أيلول من العام 2020، في أقسام التصوير الطبي في المستشفيات الفلسطينية، عن طريق استبيان تم توزيعه بشكل مباشر على الزملاء العاملين في تلك الأقسام، وكان معيار التضمين او المشاركة في الدراسة هو كافة العاملين في المجال الطبي (طبيب الأشعة، مقيم الأشعة، تقني التصوير الطبي، وممرضة قسم التصوير الطبي)، اللذين كانوا على رأس عملهم خلال الجائحة.

النتائج: تم جمع 205 استبيان، من بينها 54.5% من القطاع الحكومي، 27.2% من القطاع الخاص، 18.3% من القطاع الأهلي، كانت نسبة الإناث 26.8%، و 81.9% يحملون شهادة البكالوريوس، وحوالي 41.2% لديهم خبرة في العمل اقل من خمس سنوات. 36.1% أصيبوا بفايروس كورونا من بينهم 61.6% كان سبب اصابتهم عدوى داخل مكان العمل. كان هناك فقط 63.2% يثقون بجهوزية مستشفاهم لمواجهة جائحة كورونا و 65.1% يعتقدون بجهوزية قسم التصوير الطبي لديهم للتعامل مع الحالات المشتبه او المؤكد اصابتها بفايروس كورونا. 43.3% فقط افادوا بتلقيهم تدريبا للتعامل مع مرضى كورونا، 58.7% أفادوا بأن القراءة الذاتية هي مصدر معلوماتهم حول فايروس كورونا وما يتعلق به، كما أنه لوحظ عدم كفاية التدريب او المعرفة حول نظافة (تعقيم) اليدين والإستخدام الصحيح لوسائل الحماية الشخصية للوقاية من العدوى.

الخلاصة: نتيجة لذلك، تؤكد النتائج التي توصلنا اليها على الحاجة الحيوية لتوسيع نطاق التدريب للعاملين في أقسام التصوير الطبي على مكافحة جائحة كورونا فصلا عن تدابير الحماية والوقاية ذات الصلة، وفي سياق متصل نوصي الكليات التي تقوم بتخريج طلاب التصوير الطبي بإستحداث مساق حول الأمراض المعدية وسبل الوقاية واعتماده كمساق اجباري للطلاب.