Dahdolan, A. and Hjouj, M., Al-Quds J Nat Sci 2023: 1(3):24-30
https://doi.org/10.47874/2023:PP:2127

Al-Quds Journal for
Academic Research

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

REVIEW

Abdulkarim Dahdolan, Mohammad Hjouj *

Department of Medical Imaging, Faculty of Health Professions, Al-Quds University, P.O.Box 51000, Jerusalem, Palestine

A B S T R A C T

COVID-19 virus disease is an infectious disease caused by SARS-Cov-2 virus, as the diagnostic imaging department play a remarkable role in detecting and diagnosing of COVID-19 in early stages, therefore, medical imaging workers should be aware of infection control guidelines to prevent the transmission of the disease. A cross-sectional descriptive study survey design was conducted from July 15, 2020 to September 15, 2020, in diagnostic imaging departments in Palestine, aimed to evaluate the impact of COVID-19 pandemic on medical imaging workers; in terms of infection sources, awareness and commitment to relevant safety guidelines. 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 BA 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 PPE was noted. Our findings emphasize the vital need of expanded COVID-19 pandemic training for medical imaging workers, as well as related protective measures.

Keywords: COVID-19, SARS-Cov-2, Medical Imaging, Infection Source, Knowledge & Awareness

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, 2020). Reverse Transcription Polymerase Chain Reaction (RT-PCR) molecular test is the most commonly test used to detect COVID-19 infection (WHO, 2020). 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 for results to show up 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). Rapid Diagnostic Test (RDT) is cheaper and quicker than PCR, but it has a disadvantage of less accuracy (WHO, 2020).

Diagnostic imaging examination, mainly high resolution chest computed tomography (HRCT) and chest X-ray (CXR) play a remarkable role in detecting coronavirus disease, chest computed tomography is preferred over CXR because of its accuracy, improved contrast resolution, high sensitivity and ability to diagnose the disease in early phase of development (Zu et al., 2020; Diao et al., 2020; Shi et al. 2020). In detecting pulmonary abnormalities, HRCT is more sensitive than CXR (Ng et al., 2020). Due to their rule in COVID-19 pandemic medical imaging workers (MIWs) should be aware of infection control measures and trained in

* Correspondance:
Department of Medical Imaging, Faculty of Health Professions, Al-Quds University, P.O.Box 51000, Jerusalem, Palestine
Tel: 0545505360
Email : mhjouj@hotmail.com

the use of personnel protective equipment's (PPE) to prevent the transmission of disease. According to the Palestinian Ministry of Health, until 25 September 2021 there is 426035 total infected cases and 4286 deaths in Palestine. Among those, 6116 infected cases were health care workers (HCWs) (1.53%) (Health, 2021). The total number of infected medical imaging technologists (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).

In this study, we aim to evaluate the impact of COVID-19 pandemic on MIWs; infection sources, awareness and commitment to relevant safety guidelines. Also, compare between the components of Palestinian's health care system (Governmental private and NGOs) in terms of the preparedness of Infection Control and Prevention (ICP), PPE availability, team training, confidence of the team in hospital's preparedness for COVID-19 and number of infected MIWs in Palestine and source of knowledge about ICP..

Materials and Methods

We conducted an institutional based cross-sectional descriptive study design, from July 15, 2020 to September 15, 2020, in diagnostic imaging departments in Palestinian health system (including governmental, private and NGOs hospitals).

Ethical approval obtained from the Research Ethics Committee (REC) at Al-Quds University. Data for this study were collected from all diagnostic imaging departments in the Palestinian health system, including government and private hospitals and NGOs. All MIWs (Radiologist, Radiology Residence, Radiologic Technologists and Radiology Nurses) worked in diagnostic imaging departments during the COVID-19 pandemic were included in the study. We developed a questionnaire of 39 questions in addition to the demographic data section; Demographic information's, 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)).

However, due to the large number of MIWs in departments with different shifts, the questionnaires were distributed in the department head's office for at least one week and then the filled-in questionnaires were collected. Five hundred questionnaires were distributed to all hospitals, 207 completed questionnaires were collected, and other two were excluded due to missing the demographic data.

Statistical Analysis

The 205 valid questionnaires were exported to IBM SPSS Statistics for windows, version 23 for analysis. Descriptive statistics were used to describe the study variables. Statistical significance was considered for $P < 0.05$. The chi-square and Kruskal-Wallis Tests were used in the analysis. Reliability of knowledge, awareness and commitments to relevant safety guidelines were determined using Cronbach's alpha, which revealed scores HEP = 0.72, DEP = 0.79, SPCA = 0.70 and SPCB = 0.77.

Results

Results showed that 54.5% of respondents were from the government sector, 27.2% from private sector, and 18.3% from NGO sector. Female were 26.8%, majority of participants (49.8%) were less than 30 years' old which may explain that also the majority were less than 5 years in practice (41.2%), 81.9% of all participants holding a bachelor degree. 36.1% of all respondents were have positive COVID-19, 61.6% of those were due to nosocomial sources (Table 1).

Table 1: Demographic Data and source of infection

		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	MITs	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?	Yes	74 (36.1)
	No	131 (63.9)
If "YES" where did you get the infection from?	Nosocomial	45 (61.6)
	Home	12(16.4)
	Social Activity	7(9.6)
	Don't Know	9(12.3)

Only 50.5% of participants in governmental sector were confident with their hospital preparedness compared to 70.9% and 89.2% in private and NGOs sectors, respectively. Nearly, the same response in governmental sector in relation to the capability of medical imaging departments in dealing with COVID-19 patients, it was 52.9% which is too low compared to other sectors (Table 2).Medical imaging departments in governmental sector were allocate a separated x-ray room for suspected/confirmed COVID-19 cases, as 53.8% of participants revealed, while in private and NGOs sectors were 40.4% and 27.6% respectively (Table 2). Medical imaging departments in governmental sector were allocate a separated x-ray room for suspected/confirmed COVID-19 cases, as 53.8% of participants revealed, while in private and NGOs sectors were 40.4% and 27.6% respectively (Table 2). In their response to whether they had received training in dealing with COVID-19 patients, only 43.3% of all participants reported that they had received training, with a high correlation between the three sectors, and the lowest was in the government sector where only 29% had received training (Table 3).

Table 2: Measurements of hospital / department environment and preparedness

Hospital/Department Environment & Preparedness		Hospital Sector				*P*-Value
		Govermential	Private %	NGOs %	Total %	
Are you confidence in hospital preparedness for COVID-19?	No	49.5%	29.1%	10.8%	36.8%	< .001
	Yes	50.5%	70.9%	89.2%	63.2%	
Does your department is capable of dealing with COVID-19 patients?	No	47.1%	30.8%	11.1%	34.9%	0.001
	Yes	52.9%	69.2%	88.9%	65.1%	
Supplies necessary for hand hygiene are readily accessible in department	No	13.5%	0.0%	5.6%	7.8%	0.012
	Yes	86.5%	100.0%	94.4%	92.2%	
Hospital has made available adequate PPE during COVID-19 Pandemic	No	16.0%	6.3%	3.0%	10.9%	0.059
	Yes	84.0%	93.8%	97.0%	89.1%	
Your department allocates a separated x-ray room for suspected/confirmed COVID-19.	No	46.2%	59.6%	72.4%	54.4%	0.033
	Yes	53.8%	40.4%	27.6%	45.6%	
We clean all radiological equipment on a routine basis (e.g. weekly).	No	12.0%	2.0%	0.0%	6.9%	0.02
	Yes	88.0%	98.0%	100.0%	93.1%	

Table 3: Measurements of staff preparedness and capability

Staff Preparedness & Capability		Hospital Sector				*P*-Value
		Govermential	Private %	NGOs %	Total %	
Have you had any training for handling suspected/ infected COVID-19 patients?	No	71.0%	40.4%	42.4%	56.7%	<0.001
	Yes	29.0%	59.6%	57.6%	43.3%	
COVID-19 is transmitting via; Droplet	No	71.6%	58.2%	62.2%	66.2%	0.197
	Yes	28.4%	41.8%	37.8%	33.8%	
COVID-19 is transmitting via; Contact	No	63.3%	61.8%	78.4%	65.7%	0.194
	Yes	36.7%	38.2%	21.6%	34.3%	
I have knowledge about types of disinfectants, how to prepare and use them.	No	16.9%	2.4%	9.1%	11.6%	0.048
	Yes	83.1%	97.6%	90.9%	88.4%	
Your source of information about Infection Control and Prevention was from In-Hospital Training	No	73.4%	50.9%	51.4%	63.2%	0.005
	Yes	26.6%	49.1%	48.6%	36.8%	
I already trained on hand hygiene	No	34.9%	12.7%	8.1%	23.9%	<0.001
	Yes	65.1%	87.3%	91.9%	76.1%	
I already trained on correct use of PPE (Donning & Doffing)	No	45.7%	23.6%	8.3%	32.7%	<0.001
	Yes	54.3%	76.4%	91.7%	67.3%	
Before putting on gloves, I wash my hands or disinfect with alcohol.	No	10.9%	23.6%	5.4%	13.4%	0.022
	Yes	89. 1%	76.4%	94.6%	86.6%	

Discussion

Healthcare workers (HCWs) and Medical Imaging Workers (MIWs) were at higher risk than other people, as they work at frontlines facing this new pandemic. In 2020 researcher in China reported 3,387 infections among HCWs (4.4% of all cases) (Zhan et al., 2020). The Italian National Institute of Health also reported that 17,000 HCWs have been infected (about 10% of all cases) (Disease, 2021), and the US Centers of Disease Control and Prevention (CDC) reported that more than 9,200 HCWs were diagnosed with COVID-19 in the US between February 12 and April 9, 2020 (Burrer et al., 2020). A positive COVID-19 test was reported by 36.1% of all respondents, with 61.6% of those resulting from nosocomial sources, in terms of source of infection, similarly a study held in Helsinki University Hospital (HUS) in Finland, 53.7% of 4.7% infected persons were due to nosocomial (Oksanen et al., 2021). Also a study in Milan, on 172 HCWs with positive COVID-19 results, there was 60% due to nosocomial (Mandic-Rajcevic et al., 2020). In other study in Ontario, Canada, which was aimed to describe and compare HCWs and non-HCWs COVID-19 cases as well as the frequency of COVID-19 among HCWs, there were 4230 (17.5%) HCWs, 108 (3.1%) of them due to nosocomial infection and the majority; 2718 (76.9%) were missed due to unknown infection source (Schwartz et al., 2020).

In comparison to 89.2 % of NGOs sector and 70.9% in private sector, only 50.5 % in the government sector remains confident in hospital preparedness for the COVID-19 pandemic. In addition, nearly the same difference emerged between governmental and non-governmental participants when it came to their department's capability in dealing with COVID-19 patients, with 52.9 % of governmental participants stating that their department was capable of dealing with COVID-19 patients compared to 88.9% and 69.2% of NGOs and private, respectively. Although, our results somewhat disappointing in governmental sector, but in Libya, a study was conducted among HCWs working in emergency (ER), Intensive Care Unit (ICU) and infectious diseases departments in 21 hospitals, only about 13.4% of them reported that their hospital was prepared for COVID-19 pandemic (Elhadi et al., 2020), where only14.8% of all participants reported that they confidence and highly confidence in management of COVID-19 patients (Elhadi et al., 2020). In a study conducted in Menoufia University isolation unit, 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). Also, significant differences (P = 0.012) 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.

Not faraway, of this study results about staff training on handling COVID-19 patients, which were only 43.3% of all participants, a study held in UK reported that 48.3% of respondents had training on handling COVID-19 patients (Akudjedu et al., 2020). In a study on radiology workforce (RWF) conducted by Elshami et al., (2021), only 58% of RWF had received training on infection control for handling COVID-19 patients.

The main mechanism of transmission for the COVID-19 has been established as human-to-human transfer via droplets and contact (Zu et al., 2020). Our 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 et al., 2020) and low also compared to Elshami et al., (2021) study were 93.6% of respondents understood the mode of coronavirus transmission.

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). 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%). While, the majority of respondents in a study conducted by Coppola et al., (2021) stated that they had difficulty finding PPE, and this percentage was lower in hot areas than in other areas (64.7% vs. 71.9%, P = 0.0009), and also in another study by Huang et al., (2020) reported that only 21.2% of all respondants revealled that PPE availability was abundant and 28% responded about sufficient and available PPE. Acourding to Huang et al., (2020) a hospital's absence of PPE significantly raises anxiety levels. In addition to the risk to their mental and physical health, health care employees' work passion and efficiency would definitely suffer if they are unable to ensure their own safety. In order to appropriately protect employees and to allay their fear, each hospital should work to guarantee that the supply of protective supplies is adequate, especially in local hospitals.

About 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 HCWs 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., 2020). 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. The university's involvement in teaching ways of prevention and protection from infectious diseases is regrettably limited.

Assessments of the level of knowledge about COVID-19 among HCWs in public hospitals and primary healthcare centers in Jeddah and Najran regions in Saudi Arabia, showed that 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). Availability of a representative person for the infection control in the diagnostic imaging department has an effect on SPCB among health care sectors with a significant of $P = 0.028$ (Figure 1).

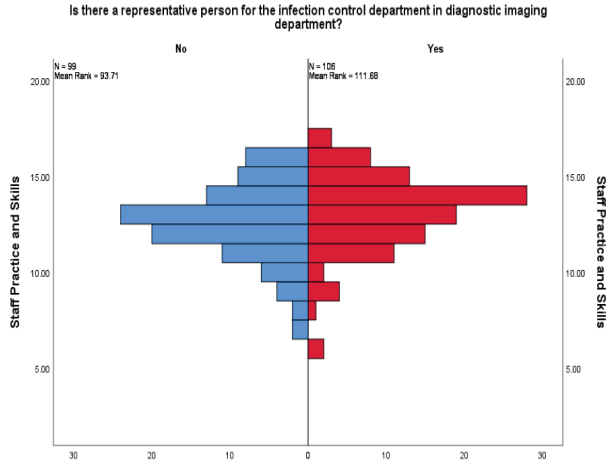

Figure 1: Effect on SPCB according to availability of representative person for the ICP in diagnostic imaging department.

While SPCA was not the same across health care sectors ($P = 0.030$) (Figure 2), this was measured by using Independent-Samples Mann-Whitney U Test. There was a significant difference ($P = 0.003$) in the effect of HEP across Health care sectors (Figure 3), and also in the effect of DEP ($P = 0.040$) (Figure 4), this was also calculated by Independent-Samples Kruskal-Wallis test, by using Kruskal-Wallis test to measure the relationship between SPCA & SPCB from a side and gender and ages of MIW, level of education, years in practice, and occupation. From other side, we find no correlation between them.

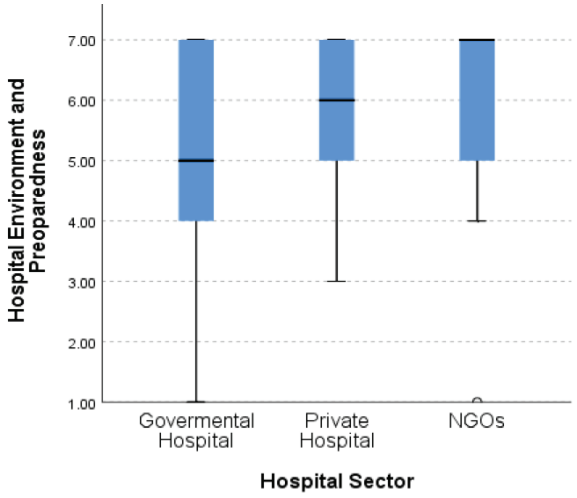

Figure 3: Distribution of HEP in relation to Hospital Sector, $P = 0.003$

Hand Hygiene means cleaning your hands by using: Any of the soap and water or Antiseptic hand wash or Antiseptic hand rub, findings could indicate that MIWs have limited understanding of ICP strategies, where only 39.7% answer that hand hygiene could be achieved by any one of these actions.

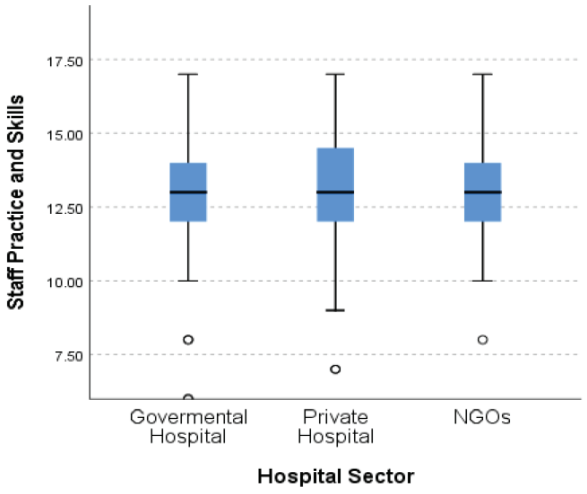

Figure 4: Distribution of DEP in relation to Hospital Sector, $P = 0.040$

While in Jeddah, Saudi Arabia, a study among students and staff of Alghad College revealed that

96.6% of participants said yes that they aware and know hand hygiene (Osman, 2020). On the other hand, 67.3% reported that they trained on the correct use of PPE, governmental participants were the least team among all sectors that they had training on PPE (54.3%). 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 a study, in 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). While in another study in Libya, only 54.3% of overall participants showed that they were prepared to utilize PPE properly (Elhadi et al., 2020).

Conclusion

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, lack of knowledge and training on proper PPE use and lack of understanding about COVID-19 transmission mode. 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 in the curriculum. To increase the level of MIWs knowledge and practices towards COVID-19 or any other infected pandemic in future; we recomend the followings; (1) the infection control department's role should be expanded in terms of providing continuous education and training to hospital employees, there should be a representative of it in every department of the hospital, including the diagnostic imaging department. (2) Infection control and prevention educational course, should be added to the curriculum of medical imaging programs at the universities.

Acknowledgements

Many thanks to all MIWs (Medical Imaging Technologist, Radiologists and Radiology Nurses), their cooperation and kindness, while collecting the data is highly appreciated.

Conflict of interest declaration

The authors declared that there is no conflict of interest

Financial Support

The authors received no financial support for the research, authorship, and/or publication of this article.

Author's contribution:

Data collection, analysis and writing was performed by the author. Corresponding author was supervising and manage the whole work step-by-step with the author.

References

Ai, T., Yang, Z., Hou, H., Zhan, C., Chen, C., Lv, W., Xia, L. (2020). Correlation of chest CT and RT-PCR testing for coronvirus disease 2019 (COVID-19) in China: a report of 1014 cases. Radiology, E32-E40.

Akudjedu, T. N., Lawal, O., Sharma, M., Elliot, J., Stewart, S., Gilleece, T., Franklin, J. M. (2020). Impact of the COVID-19 pandemic on radiography practice: findings from a UK radiography workforce survey. BJR|Open, 1-11.

Al Sulayyim, H. J., Al-noaemi, M. C., rajab, S. M., Daghriri, H. A., Al Yami, S. M., Al-Rashah, A. S., Al Salom, M. H. (2020). An Assessment of Healthcare Workers Knowledge about COVID-19. Open Journal of Epidemiology, 220-234.

Alharbi, H. S., and Mandoura, N. A. (2021). Knowledge of COVID-19 and it's Determinants among Healthcare Workers in Jeddah, Saudi Arabia. Annals of Clinical and Analytical Medicine, 332-340.

Aljondi, R., Alghamdi, S. S., Abdelaziz, I., Bushara, L., Alghamdi, S., Aljehani, A., Tajaldeen, A. (2020). Knowledge of COVID-19 infection control among healthcare workers in radiology departments in Saudi Arabia. Journal of Radiation Research and Applied Science, 51-60.

Alraddadi, B. M., Al-salmi, H. S., Jacobs-Slifka, K., Slayton, R. B., Estivariz, C. F., Geller, A. I., .Madani, T. A. (2016). Risk Factors for Middle East Respiratory Syndrome Coronavirus Infection among Healthcare Personnel. US National Library of Medicine, 1915-1920.

Burrer, S. L., Perio, M. A., Hughes, M., Kuhar, D. T., Luckhaupt, S. E., McDaniel, C. J., Walters, M. (2020). Characteristics of Health Care Personnel with COVID-19 - United States, February 12-April 9, 2020. National Library of Medicine, 477-481.

CDC (2021) Centers for Disease Control and Prevention. Retrieved from Centers for Disease Control and Prevention: https://www.cdc.gov/coronavirus/2019-ncov/variants/about-variants.html

Coppola, F., Faggioni, L., Neri, E., Grassi, R., & Miele, V. (2021). Impact of the COVID 19 outbreak on the profession and psychological wellbeing of radiologists: a natiowide online survey. Insights into Imaging , 1-12.

Diao, K., Han, P., Pang, T., Li, Y., & Yang, Z. (2020). HRCT imaging features in representative imported cases of 2019 novel coronavirus pneumonia. Precision Clinical Medicine, 9-13.

Disease, D. o. (2021, 4 17). Epicentro. Retrieved from Epidemiology for Public Health: https://www.epicentro.iss.it/en/coronavirus/bollettino/Infografica_17aprile%20ENG.pdf

Elgyoum, A. M., Zidan, M. M., Alonazi, B., & Mahmoud, M. Z. (2020). COVID-19 Prevention and control: A study of the knowledge, Awareness and attitude towards the disease among rsdiologydepartment. Balkan Medical Union, 1-8.

Elhadi, M., Msherghi, A., Alkeelani, M., Zorgani, A., Zaid, A., Alsuyihili, A., Amshai, A. (2020). Assessment of Healthcare Workers' Levels of Preparedness and Awareness Regarding COVID-19 Infection in Low-Resource Settings. The American Journal of Tropical Medicine and Hygiene, 882-833.

Elshami, W., Akudjedu, T., Abuzaid, M., David, L., Tekin, H., Cavli, B., & Issa, B. (2021). The radiology workforce's response to the COVID-19 pandemic in the Middle East, North Africa and India. Radiography, 360*368.

Fang, Y., Zhang, H., Xie, J., Lin, M., Ying, L., Pang, P., & Ji, W. (2020). Sensitivity of chest CT for COVID-19: comparison to RT-PCR. Radiology, E115-E117.

Ghonaim, M., Abed el-motaleb, T., Yehia, S., Abed El-gawad, A., Abdullah, F., & Khalil, F. (2021). The Impact of health care worker's knowledge and attitude on. Microbes and Infectious Disease, 29-42.

Hou, F. F., Zhou, F., Xu, X., Wang, D., Xu, G., Jiang, T., Zhang, K. (2020). Personnel protection strategy for healthcare workers in Wuhan during the COVID-19 epidemic. Precision Clinical Medicine, 169-174.

Huang, L., Wang, Y., Liu, J., Ye, P., Chen, X., Xu, H., Ning, G. (2020). Factors Influencing Anxiety of Health Care Workers in the Radiology Department with High Exposure Risk to COVID-19. National Library of Medicine.

Kotian, R. P., Faujdar, D., Kotian, S. P., & D'souza, B. (2020). Knowledge and understanding among medical imaging professionals in India during the rapid rise of the covid-19 pandemic. Health and Technology, 1415-1420.

Li, Y., Yao, L., Li, J., Chen, L., Song, Y., Cai, Z., and Yang, C. (2020). Stability issues of RT-PCR testing of SARS-CoV-2 for hospitalized patients clinically diagnosed with COVID-19. Journal of medical virology,, 903-908.

Longtin, Y., Sax, H., Allegranzi, B., Schneider, F., and Pittet, D. (2011). Hand Hygiene. The New England Journal of Medicine, e24-e27.

Mandic-Rajcevic, S., Masci, F., Crespi, S., Franchetti, S., Longo, A., Bollina, A., Colosio, C. (2020). Source and symptoms of COVID-19 among hospital workers in Milan. Occupational Medicine, 672-679.

Ng, M.-Y., Lee, E. Y., Yang, J., Yang, F., Li, X., Wang, H., Kuo, M. D. (2020). Imaging Profile of the COVID-19 Infection: Radiologic Findings and Literature Review Radiology:Cardiothoracic Imaging, 1-9.

Oksanen, L.-M. A., Sanmark, E., Oksanen, S. A., Anntila, V.-J., Paterno, J. J., Lappalainen, M., Geneid, A. (2021). Sources of healthcare workers' COVID 19 infections and related safety guidelines. International Journal of Occupational Medicine and Environmental Health, 239-249.

Omrani, A., and Shalhoub, S. (2015). Middle East respiratory syndrome coronavirus (MERS-CoV): what lessons can we learn? Journal of Hospiatl Infection, 188-196.

Osman, H. E. (2020). Cross-Sectional Study: Knowledge, Awareness, and Attitude Regarding COVId-19 (Coronavirus) Infection Control and Prevention among Students and Staff in Alghad College in JEDDAH. Journal of Dental and Medical Sciences, 33-41.

Palestinian Ministry of Health. Retrieved from CORONAVIRUS - COVID-19 Surveillance System: http://site.moh.ps/index/covid19/languageVersion/1/Language/ar

Schwartz, K. L., Achonu, C., Buchan, S. A., Brown, K. A., Lee, B., Whelan, M., Garber, G. (2020). COVID-19 infections among Healthcare Workers and Transmission within Households. medrxiv, 1-16.

Shazeb, M., Khan, A., & Muhammad, A. (2020). Detection of coronavirus disease (COVID-19) using radiological examinations. Journal Pure Applied Microbiology, 1-10.

Shi, H., Han, X., Jiang, N., Cao, Y., Alwalid, O., Gu, J., Zheng, C. (2020). Radiological findings from 81 patients with COVID-19 pneumonia in Wuhan, China: a descriptive study. The LANCET Infectious Disease, 425-434.

WHO. (2020, 09 20). World Health Organization. Retrieved from World Health Organization: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/question-and-answers-hub/q-a-detail/coronavirus-disease-covid-19

Yang, Y., Yang, M., Yuan, J., Wang, F., Wang, Z., Li, J., Liu, Y. (2020). Laboratory diagnosis and monitoring the viral shedding of SARS-CoV-2 infection. The innovation,, 1-7.

Zhan, M., Qin, Y., Xue, X., & Shuaijun, Z. (2020). Death from Covid-19 of 23 Health Care Workers in China. New England Journal of Medicine, 2267-2268.

Zu, Z. Y., Jiang, M. D., Xu, P. P., Chen, W., Ni, Q. Q., Lu, G. M., & Jiang, L. Z. (2020, February 21). Coronavirus Disease 2019 (COVID-19): A Perspective from China. Radiology, E15-E25.