Mediterranean Nursing and Midwifery

Mediterr Nurs Midwifery 2025; 5(1): 1-7 DOI: 10.4274/MNM.2024.23147

REVIEW

The Role of Nurses in Personal Protective Equipment Use in the Operating Theater During COVID-19 Pandemic: Are We Still Ready?

COVID-19 Pandemisinde Ameliyathanede Kişisel Koruyucu Ekipman Kullanımında Hemşirenin Rolü: Hala Hazır Mıyız?

Eva Kajti[1], Seher Deniz Öztekin[2]

[1]Department of Surgical Nursing, İstanbul University-Cerrahpaşa, Florence Nightingale Faculty of Nursing, İstanbul, Türkiye
[2]Department of Surgical Nursing, Doğuş University Faculty of Health Sciences, İstanbul, Turkey

Abstract

The coronavirus outbreak started on December 31, 2019, when the City Health Commission of Wuhan (China) reported 27 cases of pneumonia of unknown etiology. This disease, which is caused by a new coronavirus, was named as coronavirus disease-2019 (COVID-19) by the World Health Organization on February 11, 2020. This situation, which was declared a pandemic after a short time, has deeply affected the entire health system as well as the operating room. Accordingly, nurses have important roles and responsibilities related to education, management, personal protective equipment, surgery planning, patient and employee safety. In this study, nurses' roles in personal protective equipment use in the operating room during the COVID-19 pandemic was compiled in detail. Currently, while attitudes and indicators are dominated by the idea that the pandemic is close to end, we need to question of whether nurses are still ready for COVID-19 patients.

Keywords: Infection control, nurse management, patient care, staff education, surgery

Öz

Koronavirüs salgını, 31 Aralık 2019'da, Wuhan (Çin) Belediye Sağlık Komisyonu tarafından etiyolojisi bilinmeyen 27 pnömoni olgusu bildirmesiyle başlamıştır. Nedeni yeni bir koronavirüs olan bu hastalık 11 Şubat 2020'de Dünya Sağlık Örgütü tarafından koronavirüs hastalığı-2019 (COVID-19) olarak isimlendirilmiştir. Kısa süre sonra pandemi ilan edilen bu durumdan tüm sağlık sisteminin olduğu gibi ameliyathaneler de derinden etkilenmiştir. Buna bağlı olarak bilgilenme ve bilgilendirme, yönetim, kişisel koruyucu donanım, ameliyat planlanması, hasta ve çalışan güvenliği gibi konularda hemşirelere önemli rol ve sorumluluklar düşmektedir. Bu çalışmada COVID-19 pandemisinde ameliyathanede kişisel koruyucu donanım kullanımında hemşirenin rolü detaylı olarak derlenmiştir. Günümüzde tutumlar ve göstergeler pandeminin bitmesine yakın olduğu düşüncesi baskın iken, COVID-19 hastaları için hemşireler hala hazır mıdır sorusunu aklımıza getirmektedir.

Anahtar Kelimeler: Enfeksiyon kontrolü, hemşirelik yönetimi, hasta bakımı, personel eğitimi, cerrahi

Introduction

The coronavirus outbreak started on December 31, 2019, with 27 cases of pneumonia of unknown etiology reported by the Wuhan (China) Municipal Health Commission. Chinese scientists found the pathogen causing this atypical pneumonia and named it "severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2)". This disease caused by a new coronavirus was named COVID-19 by the World Health Organization (WHO) on February 11, 2020 and was declared as a pandemic (1). It is known that not all the patients who have encounter coronavirus disease-2019

Corresponding Author:
Eva Kajti, evakajti@hotmail.com

Cite this article as: Kajti E, Öztekin SD. The role of nurses in personal protective equipment use in the operating theater during COVID-19 pandemic: are we still ready? Mediterr Nurs Midwifery. 2025; 5(1): 1-7

***This study was presented as a Poster Presentation at the 4th International & 12th National Congress of Turkish Surgery and Operating Room Nurses, 14-16 January 2022.**

Received: May 12, 2023
Accepted: August 02, 2024
Epub: December 16, 2024
Publication Date: April 21, 2025

(COVID-19) demonstrates severe symptoms the disease may also progress even without any symptom. Although various organizations have continuously reported on how to take precautions to protect the patient and the surgical team in positive or suspected for COVID-19 cases requiring emergency or elective surgery, so far there has been no definite consensus among patients, physicians and health authorities (2).

The operating rooms (OR) are places where advanced technology tools/equipment are used, various surgical techniques and methods are applied in the light of recent and updated information, important decisions are made and implemented quickly that is why the teamwork is very important. In addition, due to the nature of surgical treatment and operating theatre, serial, important and risky interventions applied creates some risks for the healthcare workers. Prevention of expected/known risks is a basic approach in all working environments such it is in OR. Otherwise, unsafe/unhealthy working environments negatively affect the motivation of the employees and thus their working performance. For this reason, the basic step of increasing work performance is to create a healthy and safe working environment. When it comes to a healthy and safe working environment, it is undoubtedly the environment in which there are no/least physical and psychosocial problems. Although it is very difficult to create such an environment in the OR, it can be considered as a step to know the effects of and determining possible biological, chemical, physical and psychosocial risks according to which precautions could be taken (3).

We know with certainty that COVID-19 is transmitted from person to person, so the risk of hospital transmission poses a danger for the patients and surgical/all hospital staff (4). Operating theaters are high risk contamination areas with increased risks of aerosol generating procedures. Although OR in our country are generally well designed to deal with such high-risk situations, the high transmission risk, disease prevalence, limited resources and the additional workload increases the risk for the entire surgical team (2).

According to the latest WHO estimates as of May 19th, 2024, 36,014 new COVID positive cases were reported worldwide (5). While it draws attention a lack of data from Turkey (5). Acquiring SARS-CoV-2 infection for uninfected patients undergoing surgical procedures following a COVID positive (COVID+) patient is of significant concern, both for patients seeking medical care in hospital settings and for management of surgical services during pandemic times (6). However, findings suggest that, with implementation of infection prevention and control procedures in the operating room the risk of acquiring SARS-CoV-2 infection even when following a COVID+ patient in the same operating room, is very low (6). As study suggests, patients directly following a COVID+ patient in the OR, patients exposed within 24 h or by 48 h following a COVID+ patient in the same operating room, exposed no acquired symptomatic SARS-CoV-2 infection postoperatively. According to another study related to infection of the surgical staff who performed 152 suspected and/or confirmed COVID-19 surgeries from March 2020 to early March 2021 in Thailand, although reports of mental stress due to fear of being infected remained high, there was no proven record of intra-operative infection among them (7). Besides that, healthcare workers should be protected at every stage of their service delivery, this protection should be known in detail by every team member and should be applied immediately in positive or suspected for COVID-19 cases. The use of personal protective equipment (PPE) in surgical units can be addressed in 3 stages: Preoperative (or patient evaluation), intraoperative and postoperative. For the subject to be explained in details and as the pre- and postoperative periods usually takes place outside of the OR, only the perioperative period was considered.

Anesthesia and surgical intervention may adversely affect the course of COVID-19 disease. According to a study conducted in France, 15 of 305 patients who had surgery affecting the gastrointestinal system were infected with COVID-19, so the risk of SARS-CoV-2 infection during hospitalization or following digestive surgery is a real and potentially serious risk. It is necessary to minimize this risk and take necessary precautions so we can be able to return to safe surgical activities (8). In patients suspected or positive for COVID-19, the recommended practice is to cancel or postpone all non-emergency surgeries (1,9-11). Moreover, the American College of Surgeons emphasizes that institutions should not start elective surgery before providing enough PPE for one month (9).

According to WHO, correct use of PPE for COVID-19 Provisional Guideline (February 2020) some PPE management techniques are as following: The management of PPE should be coordinated with important national and international supply chain management mechanisms. To ensure the efficiency of the requested PPE, accurate counting models-based controls are recommended. Monitoring and control of PPE requests from countries and large response teams should be ensured. Strict adherence to basic stock management rules should be made to encourage the use of a centralized demand management approach to avoid duplication of stocks and to limit waste, stock and stock breakdowns. Tracking PPE distribution should include monitoring and control of PPE circulation in healthcare facilities (1). Institutions should also include in their routine, data collection and information on PPE presence, stock and supplies. PPE needs should be calculated by using well known methods by a multidisciplinary team. In order to determine the need for PPE, each institution should be aware of its patient capacity, staff and relations with the patients, working hours, number of breaks of healthcare workers using PPE, location of the isolation area and material supply strategy, waste management, laboratory location, number of laboratory tests, material supply system of the hospital and patients length of stay in the hospital (12). Still, institutions should evaluate their needs on a case-by-case basis and calculate them by adding to the factors mentioned above. Considering that a large number

of materials cannot be stored in institutions or that the material procurement may take time, it is recommended to evaluate the PPE requirement at certain intervals (e.g., every 8 hours) and to assign this task to certain persons (12). The PPE calculator developed by the centers for disease control and prevention for the Ebola epidemic can be considered for PPE calculation (https://www.cdc.gov/vhf/ebola/healthcare-us/ppe/calculator.html).

Use of PPE in the Operating Room

Experience out of China and Singapore have demonstrated that screening by symptoms and routine testing, use of appropriate PPE, as well as a coordinated plan involving all aspects of peri-operative care is essential (13).

According to the WHO COVID-19 outbreak: Rights, roles and responsibilities of healthcare professionals (HCP), Health and Safety Guidelines for Healthcare Professionals, HCP are responsible of properly wear, use, remove and waste of PPE (13). In addition, according to the Turkish Ministry of Health's COVID-19 (SARS-CoV-2 infection) Guidelines (April 12, 2020); healthcare workers having extensive contact with COVID-19 patients with/without a medical (surgical) mask while donning all PPE properly are not considered risky (14).

Based on this information prior to every operation standard precautions are recommended for all patients. Standard precautions include hand and respiratory hygiene, proper PPE use according to risk assessment, injection safety practices, safe waste management, appropriate linens, environmental cleaning and sterilization of patient care equipment. The rational, correct and consistent use of PPE helps reduce the spread of pathogens. Effective use of PPE depends on adequate and regular resources, adequate staff training, proper hand hygiene and especially appropriate human behavior.

Since in all suspected or positive for COVID-19 cases full PPE donning is recommended before any clinical intervention (15) this is the rationale why healthcare personnel who will attend surgery must wear PPE under surgical/sterile equipment. It is extremely important for all personnel to use PPE in all interventional procedures that are in close contact with the patient, for example during surgical intervention, intubation, local anesthesia, cannulation or catheterization (2). In addition, the entire surgical team should be trained in wearing and removing PPE in order to prevent contamination (16). According to the recommendation of the Turkish Intensive Care Nurses Association, four to six hour shifts are to be completed without changing clothes (as much as possible). It is recommended to change PPE for shifts of eight hours or more in accordance with the donning-doffing procedures (15). However, using the same breathing filter/mask for more than 4 hours can cause discomfort and should be avoided (1).

It should be noted that when coming from the inpatient floor, patients should wear a medical mask. In addition, HCP accompanying the patient from the floor to the operating room should wear all protective equipment (N95 mask, protective glasses or visor, waterproof gown and foot protector) properly and properly (4). According to the American College of Surgeons, first of all, a guide should be prepared on PPE to be used during surgery, the number of personnel should be limited to only the necessary personnel and all unnecessary materials, equipment and medical personnel should be excluded from the operating room (9,17,18). Also prior surgery signs should be placed on the door stating that there is a COVID-19 case and that other personnel should not enter the room without PPE.

Despite the wide variety of PPE and its use, PPE, which is necessary in a surgical procedure, is recommended by many institutions and their use is a must. Before entering the operating room, jewelry (ring, watch, etc.) should be removed, keys, wallet, phone, etc. should be left out. Employees involved in the surgical team should be evaluated among level 3 infection control measures and should be provided with full protective equipment [disposable bonnet, medical mask N95 and above, powered air purifying respirator (PAPR), operating room uniform, disposable gloves and disposable foot protector] (10,18,19).

The presence of all PPE that needs to be worn complicates the operation and makes it harder so the process can be uncomfortable and unusual. Working with full PPE can be tiring, and breaks may be required to prevent fatigue while performing lengthy surgical procedures (20).

Wearing face masks and visors can also significantly reduce the clarity of verbal communication between operating room staff. Also, reading non-verbal clues can be more difficult than usual, which may increase medical errors, a subject of separate (20). All surgical personnel (including surgeons, anesthesiologists, scraps and circulating nurses and operating room nurses) must put their PPE in the buffer room before entering the operating room: It's appropriate for the entire surgical team to don, double-layer caps, medical protective mask (N95), medical goggles, medical protective clothing, boot covers, latex gloves and an electric air cleaner (21). It should be noted that in this process, the surgical team should be limited to a minimum of people and irrelevant personnel should be prevented from entering the operating room. Surgeons and nurses should wear disposable sterile surgical gowns and sterile gloves after hand washing, in addition to PPE as outlined above.

In detail, the PPE that the surgical team should wear in suspected or positive for COVID-19 cases is as follows:

Protective overalls: Clothes/waterproof apron over hospital uniforms.

Mask: In the presence of aerosol, conventional surgical masks do not provide protection, so N95 and/or FFP2/FFP3 should be used. For the masks to fit perfectly, beard shaving is recommended.

Goggles or face shield: If there is aerosol presence, glasses that cover the eyes should be used, otherwise the semi-protected shield is sufficient to prevent the risk of contamination from splashing.

Gloves: Long gloves are recommended. Also, use of sand barrier gloves (with mechanical puncture barrier) or disinfectant gloves may be considered.

Cap: Hairs should be properly tied up under the cap.

Shoes: Sterilizable rubber boots that cover the feet completely should be preferred (15,22,23).

After this preparation, normal sterile surgical equipment can be worn (16). Prior the operation, it must be ensured that the entire team is wearing PPE. After the patient enters the operating room, HCP circulation should be limited or when possible prohibited.

After surgery PPE should be properly removed in a designated area, avoiding contamination, and disposed of in medical waste. Operating room staff should wear different PPE if they are to accompany the patient outside of the operating room (24). Outer glove should be removed immediately as it is the most contaminated equipment. Other equipment is also considered contaminated and accordingly, overalls, foot protectors and bonnets are removed first, then the mask and glasses are removed. It's important to hold the mask only by the strings and to not touch the front part of the mask. The inner glove is removed last and hand hygiene is ensured immediately with alcohol-based hand sanitizer. It's recommended that staff takes a shower whenever possible. It should be noted that during the postoperative OR cleaning the relevant personnel should wear all PPE while collecting medical waste and during this time nursing supervision is recommended (24).

A PPE Donning and Doffing Checklist Example

Some institutions PPE donning and doffing guidelines and checklists, such as the University of South Carolina Health or the University of Kansas are available for access and use (9,25).

The procedure for donning and doffing PPE in the OR from South Carolina Health University is as follows:

Donning PPE

1. Remove personal items on head/neck (e.g., earrings, necklaces, etc.),

a. Eyeglasses can remain on,

b. Tip: Long hair should be placed in a braid or bun. A hair band should be used to keep hair away from the face,

2. Don cloth OR hat or disposable skull cap,

3. Don boot covers,

4. Perform hand hygiene,

5. Don N95 and perform seal check,

6. Don Bouffant cap,

7. Don eye protection (choose from options below) with second mask placed over N95,

a. Mask with attached face shield (inverted) PLUS simple surgical mask over N95 (for N95 preservation),

b. Full face visor (reusable ones acceptable if cleaned in decontamination solution),

c. Disposable visor glasses PLUS simple surgical mask over N95 (for N95 preservation),

d. Reusable goggles PLUS simple surgical mask over N95 (for N95 preservation),

8. Remove ALL communication devices including cell phones and pagers. Remove hospital ID badge. These should be left outside the OR entrance on a table manned by the runner. Clean items with disinfectant wipes.

9. Perform standard surgical scrub after dofficer confirms good respirator, eye protection and mask fit,

10. Enter OR (runner can open door if needed),

11. Don first pair of sterile gloves (undergloves),

12. Don surgical gown with assistance from circulator (circulator in non-sterile PPE8),

13. Don second pair of sterile gloves over gown cuffs (overgloves) (9,25,26).

* The second surgical mask should only be worn if N95 masks are to be reused after decontamination during times of scarcity. The N95 mask should only be removed after leaving the operating room (9,25).

Doffing PPE

During PPE removal outlined in 12 steps, the circulator nurse helps, observes/coaches and can read each step from the checklist aloud. Steps 1-12 should be performed in the OR.

1. Wipe off gross contamination from overgloves with OR towel, dispose in biohazard trash,

2. Perform hand hygiene (will have to use hand gel) over overgloves,

3. Remove boot covers and dispose in biohazard trash,

4. Perform hand hygiene over overgloves,

5. Remove gown and overgloves, rolling the gown and gloves together in one unit and dispose in biohazard trash,

6. Perform hand hygiene over undergloves,

7. Remove visor and place in decontamination solution if reusable, biohazard trash if disposable mask/visor combo. If removing the visor/mask combo, take care to avoid touching the front of the mask. May require assistance from dofficer to remove mask safely,

8. Perform hand hygiene over undergloves,

9. Remove outer bouffant and place in biohazard trash,

10. Perform hand hygiene over undergloves,

11. Remove undergloves and place in biohazard trash,

12. With runner opening door so as not to touch door, exit OR,

13. Perform hand hygiene, 20 seconds duration with soap and water,

14. Remove N95. If reusable type mask, place in bag for decontamination,

15. Perform hand hygiene,

16. Go to locker room and dispose of scrubs, shower before leaving OR area (9,25,26).

While preparing this study Turkey and all over the world slowly moved to the normalization process and according to the Guideline for Care in Health Institutions during the Normalization Period in the COVID-19 Pandemic (June 1, 2020), there was no different recommendation regarding the use of PPE and standard measures in the OR. Current practices are recommended to continue during all the pandemic period. At the same time before the planned surgical procedures are initiated, considering that the number of cases may increase over time, it is recommended to provide PPE stocks for at least 30 days of surgical activity. The availability of adequate PPE is confirmed during the preoperative team preparation. At a minimum, PAPR with hoods must be available for the anesthesia provider, surgeon and surgical technician, recognizing the Anesthesia Patient Safety Foundation recommendation that these devices confer superior protection for those with the highest risk and most proximate exposure to the patient throughout the case. An N95 respirator, at minimum, must be available for the circulating OR nurse (27).

The necessary PPE should be provided to the employees, it should be located in easily accessible places and its correct use should be ensured. PPE stocks should be monitored regularly. Proper use of PPE should be ensured by guidelines. Guidelines should be shared with all employees and improper use of PPE should be prevented.

PPE Use in the Operating Room During COVID-19 and the Role of the Nurse

Surgical nurses in line with ethical principles are legally responsible for the quality of their practices and care. It is also important that they undertake the responsibility of protecting their own physical and mental health while providing qualified care to patients and society (24). Nurses, as the most important and closest HCP to the patients, face great risks so they need to assume the necessary role and responsibility in conducting prevention and control efforts to cope with the challenges of epidemics such as COVID-19 (24). In addition, due to the nature of OR, the use of advanced technology creates many dangerous situations. In the OR, nurses may be exposed to numerous risks, including biological, chemical (soap, detergent, latex, radiation, etc.), physical (lighting, noise, etc.) and ergonomic. Nowadays one of the most dangerous biological hazards is the highly contagious SARS-CoV-19 virus. It should be emphasized that during the COVID-19 pandemic, not only the physical but also the mental health of nurses comes into prominence, and both factors should be carefully evaluated. Regarding the physical health, one of the most important means of protection is the use of PPE. The use of PPE has always been a basic and continuous part of nursing education accordingly nurses have an important role in the correct use and supply of PPE. However no properly resources were found regarding the role of the nurses in PPE use in the OR during COVID-19 pandemic.

The roles of the OR nurse in charge and OR nurses are briefly mentioned in a Chinese source. According to this source: The OR nurse in charge activates the team, deploy staff and pass key to controlled drugs, handover pouch to OR runner with the following: mobile phone, PPE cupboard key and card access. In addition, OR nurse in charge should receive feedbacks from the OR nurse throughout the process and make sure that the necessary equipment is provided (28).

The OR nurses role; nurses should undertake the responsibilities of donning full PPE and/or PAPR, prepare OR accordingly, scrub nurse to scrub up and prepare trolley, circulating nurse to pass all additional consumables/ instruments to runner (before patients enters OR), park patients trolley in AnteRoom after transfer. Circulating nurse contacts OR runner if any other item is required and retrieves requested items from the AnteRoom. Telephonic or other electronic tools use to facilitate communication from inside to outside the OR to minimize door opening and foot traffic is recommended (29).

If specimen handling is needed circulating nurse places the double bagged samples into a cooler box and handles it to the porter which don only gloves during transport. After surgery OR should not be ventilated, instruments used are sent directly to the sterilization unit and all unused materials and medicines are threw away. Circulating nurse wears a pair

of gloves and protective gowns and a visor while counting materials (30). Circulating nurse returns the keys to the nurse in charge and performs telephone handover with the ward nurse (28). Trainings on proper donning and doffing of PPE including infection control protocols, donning and doffing of N95 mask, PAPR, goggles, face shield, gowns and gloves should be planned and repeated to the whole team at regular intervals. A team meeting should be held before the surgery for everyone to understand the anesthesia and surgery plan, to ensure that all necessary medicines and equipment are prepared and to ensure that the process is going smoothly. In case of any damage that may occur in PPE, information about control, cleaning, disinfection and storage should be provided. All personnel should be aware that communication is more difficult after PPE is worn and should take special care to facilitate communication during the procedure.

Prior to incision a second time out is performed to confirm the previously verified operative site and plan. During the case, the assistants to the OR nurse and anesthesia provider act as facilitators or "runners" for equipment retrieval and communication with the outside OR staff. These roles are assigned to personnel who are familiar with the layout and day-to-day functioning of the ORs, such as anesthesia technicians and OR circulating nurses. All staff agreed on a strategy of no breaks or alternations whenever possible to conserve PPEs (27).

It is known from the literature and daily practice that the use of PPE during surgery makes the procedure very difficult. However, it should be emphasized that the most effective way of protection from this life-threatening disease is the use of PPE, this awareness will lead the HCP to overcome this process by continuing their sacred duties in safety and without experiencing any disease. Since the use of PPE is always a basic and continuous part of nursing education, nurses have an important role in the correct use and supply of PPE. The perioperative nurse must strictly implement infection control measures like using face mask at times, hand hygiene. Social distancing must be strictly implemented when eating meals; use of personal or disposable utensils is encouraged to prevent contamination (29).

It is important for surgical nurses and specialists to stay up to date with the latest information concerning safety measures in the OR given the fact that PPE has been shown to offer protection against respiratory infections, especially COVID-19 (31). The newest literature should be closely followed so that the best practices are instituted and upgraded (32).

Footnotes

Author Contributions: Surgical and Medical Practices – E.K., S.D.Ö.; Concept – E.K.; Design – E.K., S.D.Ö.; Data Collection and/or Processing – E.K.; Analysis and/or Interpretation – E.K., S.D.Ö.; Literature Review – E.K.; Writing – E.K., S.D.Ö.

Declaration of Interests: No conflict of interest was declared by the authors.

Funding: The authors declared that this study received no financial support.

References

1. WHO. (2020, 06 07). World Health Organization. World Health Organization. Available from: https://www.who.int/ [Crossref]
2. ACS. (2020, 05 01). American College of Surgeons. ASC Available from: https://www.facs.org/ [Crossref]
3. Aksoy G. Cerrahi ve Cerrahi Hemşireliği. Aksoy G. Kanan N. İçinde: Cerrahi Hemşireliği. İstanbul: Nobel Tıp Kitapevleri; 2017; 1-36. [Crossref]
4. Al-Balas M, Al-Balas HI, Al-Balas H. Surgery during the COVID-19 pandemic: A comprehensive overview and perioperative care. Am J Surg. 2020;219(6):903-906. [Crossref]
5. WHO. (2024, 06 05). World Health Organization. Retrieved from World Health Organization. https://data.who.int/dashboards/covid19/cases?n=c [Crossref]
6. Axiotakis LG Jr, Boyett DM, Youngerman BE, McKhann GM, Lalwani AK. SARS-COV-2 transmission rate is low when following a COVID+ patient in the operating room. Langenbecks Arch Surg. 2021;406(2):401-404. [Crossref]
7. Giwangkancana G, Rahmi A, Indriasari, Hidayat NN. Managing surgical patients with a COVID-19 infection in the operating room: An experience from Indonesia. Perioper Care Oper Room Manag. 2021;24:100198. [Crossref]
8. Dolgun E, Van Giersbergen MY. Ameliyathanede kimyasal madde güvenliği. Ege Üniversitesi Hemşirelik Fakültesi Dergisi. 2016;32(1):130-140. [Crossref]
9. CAI Hongliu CY. (2020). Handbook of COVID-19 prevention and treatment. Zhejiang University School of Medicine. [Crossref]
10. CDC (2020, 05 02). CDC. CDC Available from: www.cdc.org [Crossref]
11. Coccolini F, Perrone G, Chiarugi M, Di Marzo F, Ansaloni L, Scandroglio I, et al. Surgery in COVID-19 patients: operational directives. World J Emerg Surg. 2020;15(1):25. [Crossref]
12. Coimbra R, Edwards S, Kurihara H, Bass GA, Balogh ZJ, Tilsed J, et al. European Society of Trauma and Emergency Surgery (ESTES) recommendations for trauma and emergency surgery preparation during times of COVID-19 infection. Eur J Trauma Emerg Surg. 2020;46(3):505-510. [Crossref]
13. DSÖ (2020). Koronavirüs hastalığı (Covid-19) Salgını: Sağlık çalışanlarının hakları, rolleri ve sorumlulukları sağık çalışanlarının sağlığı ve güvenliği. [Crossref]
14. DSÖ (2020). Koronavirüs hastalığı için kişisel koruyucu ekipmanların doğru kullanımı 2019 (COVID-19) geçici rehber. [Crossref]
15. Evans HL, Thomas CS, Bell LH, Hink AB, O'Driscoll S, Tobin CD, et al. Development of a sterile personal protective equipment donning and doffing procedure to protect surgical teams from SARS-CoV-2 exposure during the COVID-19 pandemic. Surg Infect (Larchmt). 2020;21(8):671-676. [Crossref]
16. Forrester JD, Nassar AK, Maggio PM, Hawn MT. Precautions for operating room team members during the COVID-19 pandemic. J Am Coll Surg. 2020;230(6):1098-1101. [Crossref]
17. He Y, Wei J, Bian J, Guo K, Lu J, Mei W, et al. Chinese society of anesthesiology expert consensus on anesthetic management of cardiac surgical patients with suspected or confirmed coronavirus disease 2019. J Cardiothorac Vasc Anesth. 2020;34(6):1397-1401. [Crossref]

18. Kamer E, Çolak T. What to do when a patient infected with COVID-19 needs an operation: a pre-surgery, peri-surgery and post-surgery guide. Turk J Colorectal Dis. 2020;30:1-8. [Crossref]
19. Karaca AS, Ozmen MM, Uçar AD, Yastı AÇ, Demirer S. COVID-19'lu hastalarda genel cerrahi ameliyathane uygulamaları. Turk J Surg. 2020;36(1):6-10. [Crossref]
20. Luong-Nguyen M, Hermand H, Abdalla S, Cabrit N, Hobeika C, Brouquet A, et al. Nosocomial infection with SARS-Cov-2 within departments of digestive surgery. J Visc Surg. 2020;157(3S1):S13-S18. [Crossref]
21. COVID-19 pandemisinde normalleşme döneminde sağlık kurumlarında çalışma rehberi, İstanbul. [Crossref]
22. RACS. (2020, 08 11). Surgeons.org. Retrieved from surgeons: https://www.surgeons.org/-/media/Project/RACS/surgeons-org/files/news/covid19-information-hub/2020-05-05-covid19-ppe-guidelines.pdf?rev= 396925b47e41461 da79038b 301b52381 &hash=444212FE2C8 7FCAC0C79525CF77ABB46 [Crossref]
23. CDC. (2024, 03 18). www.cdc.gov. Retrieved from Centers for Diasease Prevention and Control: https://www.cdc.gov/coronavirus/2019-ncov/hcp/infection-control-recommendations. html [Crossref]
24. Ti LK, Ang LS, Foong TW, Ng BSW. What we do when a COVID-19 patient needs an operation: operating room preparation and guidance. Can J Anaesth. 2020;67(6):756-758. [Crossref]
25. TJOD. (2020, 04 28). Available from: https://www.tjod.org/tum-acil-cerrahiler-icinhasta-hazirligi_/ [Crossref]
26. ACEP. (2023, 09). www.acep.org. Retrieved from American College of Emergency Phisicians: https://www.acep.org/corona/covid-19-field-guide/work-safety/appropriate-ppe/ [Crossref]
27. Arora V, Evans C, Langdale L, Lee A. You need a plan: A stepwise protocol for operating room preparedness during an infectious pandemic. Fed Pract. 2020;37(5):212-218. [Crossref]
28. Türk Yoğun Bakım Hemşireleri Derneği. (2020). Yoğun bakım ünitesinde görev alacak hemşireler için kaynak kitapçık Covid-19 pandemisine özel, İstanbul. [Crossref]
29. ORNAP. (2020). Recommended guidelines on perioperative nursing management during COVID- 19 Pandemic. Philippines: https://ornap.org/wp-content/uploads/2020/07/ORNAP_RECOMMENDATION_on_COVID-19_Perioperative_Nursing_Management_071020.pdf. [Crossref]
30. Wang H, Feng J, Shao L, Wei J, Wang X, Xu X, et al. Contingency management strategies of the nursing department in centralized rescue of patients with coronavirus disease 2019. Int J Nurs Sci. 2020;7(2):139-142. [Crossref]
31. Kening MZ, Groen K. Personal Protective Equipment. 2023 Feb 22. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024. [Crossref]
32. Prakash L, Dhar SA, Mushtaq M. COVID-19 in the operating room: a review of evolving safety protocols. Patient Saf Surg. 2020;14:30. [Crossref]