







REVIEW ARTICLE

Health professionals' safety in the management of surgical patients in the COVID-19 context: an integrative review

Segurança dos profissionais da saúde no manejo de pacientes cirúrgicos no contexto COVID-19: revisão integrativa

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ABSTRACT

Objective: to identify the conducts and personal protection equipment that health professionals need for the surgical care of patients with suspected or confirmed cases of COVID-19. **Methods:** integrative review performed in the Latin American and Caribbean Health Sciences Literature and National Library of Medicine databases with articles published between November 2019 and September 2020. **Results:** resulted in 13 articles grouped into two themes: Personal Protective Equipment necessary for the use by health professionals in the care of surgical patients and Conducts related to the use of Personal Protective Equipment in the same context. **Conclusion:** equipment necessary for surgical care are N95/PFF2 mask, face shield or goggles, long-sleeved waterproof aprons, knee-length shoe protector, cap and double gloves. These findings contribute to help health professionals to protect themselves and choose the necessary equipment for providing care to COVID-19 patients.

Descriptors: Coronavirus Infections; Surgicenters; Personal Protective Equipment.

RESUMO

Objetivo: identificar as condutas e equipamentos de proteção individual que profissionais da saúde necessitam para a assistência cirúrgica a pacientes com suspeita ou caso confirmado de COVID-19. **Métodos:** revisão integrativa, realizada nos bancos de dados Literatura Latino Americana e do Caribe e *National Library of Medicine*, publicados entre novembro de 2019 a setembro de 2020. **Resultados:** resultou em 13 artigos, agrupados em duas temáticas: Equipamentos de Proteção Individuais necessários para o uso dos profissionais da saúde na assistência a pacientes cirúrgicos e Condutas relacionados ao uso de Equipamentos de Proteção Individuais no mesmo contexto. **Conclusão:** equipamentos necessários para a assistência cirúrgica: máscara N95/PFF2, protetor facial ou óculos de proteção, aventais impermeáveis de mangas compridas, protetor de calçados na altura dos joelhos, gorro e luvas duplas. Estes achados contribuem para auxiliar os profissionais da saúde a se protegerem e escolherem os equipamentos necessários para ofertar a assistência a pacientes com COVID-19.

Descritores: Infecções por Coronavírus; Centros Cirúrgicos; Equipamento de Proteção Individual.

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INTRODUCTION

The disease caused by the Severe Acute Respiratory Syndrome virus (SARS-CoV-2) is called COVID-19 (the New Coronavirus Disease) and was first recognized in humans in late 2019, in Wuhan, China. It spread around the world and is currently considered a pandemic⁽¹⁾. In September 2020, it is estimated that more than 30 million people have been infected in the world, out of which almost one million have died⁽²⁾.

The transmission routes of COVID-19 recognized so far are by close contact with infected people, contact with contaminated surfaces or objects, inhalation of droplets eliminated by coughing or sneezing, and by aerosolization during airway management procedures, such as intubation, extubation, secretion aspiration, manual and mechanical ventilation, cardiopulmonary resuscitation and bronchoscopy, in addition to other procedures under study⁽³⁾.

Individuals infected with the SARS-CoV-2 virus present symptoms ranging from mild, moderate and severe, and approximately 5% of patients may need critical care in advanced care units⁽³⁾. The most common clinical manifestations in patients with suspected or confirmed cases of COVID-19 are fever, cough, dyspnea, fatigue, myalgia, mental confusion, headache, chills, diarrhea, anosmia, ageusia, sore throat, among others⁽¹⁻⁴⁾.

Critical care in the hospital environment for patients with severe disease manifestations requires the use of resources and interventions that help maintain life and reduce morbidity. Health professionals and their expertise play extremely important roles in caring for these patients. However, the vulnerability of these professionals becomes a matter of concern for health organizations, professional councils and the society, as they are at greater risk than the general community to get contaminated and present a picture of COVID-19⁽⁵⁾.

A significant portion of the millions of individuals infected by SARS-CoV-2 is made up of health professionals on the front line of care who became infected during care for patients with the virus⁽⁵⁾. As the workforce of health professionals is essential, it is necessary to guarantee their safety and protection and prevent them from being contaminated in order to continue providing care. Thus, it is important to consider the best practices and strategies to protect this group of professionals, considering the proper precautions and protective equipment⁽²⁾.

Among the health care practices in the hospital setting that require the care by health professionals, surgical intervention is an assistance that saves lives and restores people's health conditions. Approximately 234 million surgeries are performed annually in the world, even though many elective interventions had to be postponed this year because of the pandemic⁽⁶⁾.

Exposure to biological agents in the operating room environment is described as an occupational hazard for health professionals⁽⁷⁾. The Centers for Disease Control and Prevention (CDC) describes which standard and specific protective measures are necessary for the different transmission routes in the hospital environment⁽⁸⁾. In the context of the SARS-CoV-2 virus, in addition to standard precautions, others must be adopted, such as: from contact, droplets and in specific cases, from aerosol⁽⁵⁻⁹⁾. Personal Protective Equipment (PPE) and environmental care comprise strategies that minimize the exposure of health professionals to these pathogens. However, the COVID-19 pandemic led to a shortage of PPE in various locations around the world that made access to this equipment very difficult⁽⁷⁻¹⁰⁾.

Thus, the decision to postpone elective surgical procedures was made based on the high occupational risk, high transmissibility of the SARS-CoV-2 virus, overload of health units and difficulty in accessing PPE. Only urgent and emergency surgeries were maintained, until there were epidemiological conditions, a sustained decrease in new cases of COVID-19, an increase in the availability of Intensive Care Unit (ICU) beds, ward beds and PPEs in sufficient quantity and quality so that these care measures could be safely resumed⁽¹¹⁾.

Recently, with the movement to resume elective surgeries, the higher number of surgical patients and, consequently, greater access to and demand for PPEs, health units are adapting and developing strategies based on government agencies for the healthcare of patients with suspected or confirmed case of COVID-19, evidencing the occupational health of health professionals.

However, many health institutions that provide surgical care do not have consistent protocols for the conduct and use of necessary PPE, emphasizing and preventing the occupational health of health professionals.

Thus, the following investigative question was raised: what conducts and personal protective equipment do health professionals need for providing surgical care to patients with suspected or confirmed cases of COVID-19? The aim of this study is to identify in the literature the conducts and personal protection equipment that health professionals need for providing surgical care to patients with suspected or confirmed cases of COVID-19.

METHODS

This is an integrative review, which allows a methodological analysis of scientific articles, definitions and concepts by means of secondary data of scientific evidence and bibliographic survey of updated prior information, thereby contributing to the reading of authors and researchers⁽¹²⁾.

The study consisted of the following steps: theme identification; definition of the research problem through the PICO strategy and study objective; establishment of inclusion and exclusion criteria for publications; definition of search criteria in the literature; categorization of studies; analysis of studies included in the integrative review; interpretation of results; and, synthesis of knowledge⁽¹³⁾.

After the first step of the theme identification, the study hypothesis was raised, based on the PICO strategy that represents an acronym for (P) - patient, problem population, (I) - intervention, (C) - comparison and (O) - outcomes⁽¹³⁾. These resulted in the investigation question: what conducts and personal protective equipment do health professionals need for providing surgical care to patients with suspected or confirmed cases of COVID-19?

The search for scientific articles was performed from July to September 2020 in the databases of the Latin American and Caribbean Health Sciences Literature (LILACS) and National Library of Medicine (PubMed) using the Health Sciences Descriptors (DeCS) and the Medical Subject Heading (MESH) through Boolean operators, as shown in Table 1.

Table 1. Description of the search for scientific articles in the database.

Health Sciences Descriptor (DECS)	Boolean Operator	Database
Infection from coronavirus	"AND"	LILACS*
Surgical Centers	"OR"	LILACS*
Personal Protective Equipment	"OR"	LILACS*
Medical Subject Heading (MESH)	Boolean Operator	Database
Individual protection equipment	"AND"	PubMed**
COVID-19	"OR"	PubMed**
Surgery	"AND"	PubMed**

* LILACS – Latin American and Caribbean Health Sciences Literature.

** PubMed – National Library of Medicine.

Inclusion and exclusion criteria

References were selected based on the reading of titles and abstracts that met the inclusion criteria of original scientific articles in Portuguese and English published between November 2019 and September 2020. Then, full texts of each selected article were read, seeking to choose the studies that answered the study question. After this process, articles that did not respond to the research hypothesis, monographs, dissertations and theses were excluded.

Organization of data

The PRISMA method (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) was used to summarize data⁽¹⁴⁾. Articles were selected and classified by the thematic affinity identified from the reading of the title, objective, results and conclusions, seeking to choose those that answered the guiding question.

After classification, each article was read in full, collected data were compiled and entered into a Microsoft Word spreadsheet containing number, article name, author, year, database/recommendations from government agencies, objective, type of study, scientific evidence and level of evidence.

The assessment of the level of evidence resulted from the following stratification; level 1: evidence arising from meta-analysis of controlled and randomized clinical trials; level 2: evidence obtained from individual studies with experimental design; level 3: evidence from quasi-experimental studies; level 4: evidence from descriptive studies (non-experimental) or qualitative studies; level 5: evidence from case or experience reports; level 6: evidence based on expert opinions⁽¹²⁾.

RESULTS

As a result of the search in databases, 80 scientific articles evaluated in full were selected. Thirteen out of this total were selected, according to the inclusion and exclusion criteria of the study. Of the 13 (100%) articles, ten (76.9%) were published in the LILACS database indexed in the Virtual Health Library (VHL) and three (23.1%) were published in PubMed. Figure 1 presents the flowchart of the selection process of studies included in this integrative review.

Among the studies included, seven (54%) articles were classified as level of evidence 1, two as level 5 (15.3%) and four as level 6 (30.7%). Regarding language, 12 (92.3%) articles were published in English and one (7.7%) in Portuguese. Regarding the year of publication, 100% were published in 2020, given the pandemic moment currently experienced worldwide.

The selected scientific articles were grouped into two themes that responded to our study question: theme 1 - PPE necessary for the use by health professionals in the care of surgical patients in the context of COVID-19; and theme 2 - Conduct related to the use of PPE by health professionals in the care of surgical patients in the context of COVID-19.

Of the 13 (100%) articles selected for our integrative review, five (38.5%) addressed both the theme 1 and theme 2, six (46.1%) addressed only the theme 1 and two (15.4%) addressed the theme 2. Data are presented in Tables 2, 3 and 4 referring to the themes mentioned above.

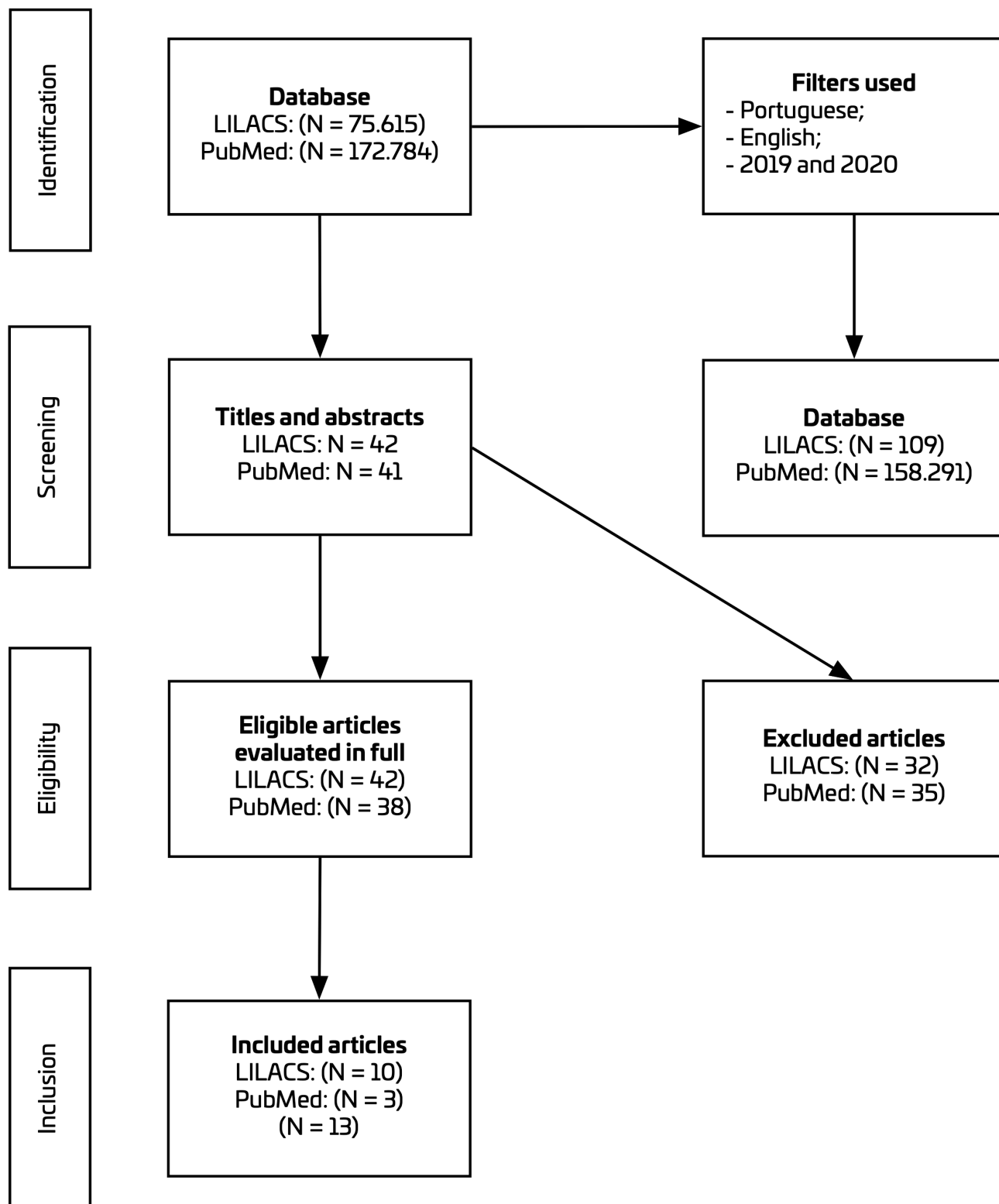
Figure 1. Flowchart based on the PRISMA checklist with results from the selection of articles.

Table 2. Scientific articles grouped in themes 1 and 2.

N	Author / year / database	Theme 1 - PPE necessary for the use by health professionals in the care of surgical patients in the context of COVID-19	Theme 2 - Conduct related to the use of PPE by health professionals in the care of surgical patients in the context of COVID-19
01	BENÍTEZ et al. / 2020(15) / PubMed	PPE intended for surgical care are N95/PFF3 respirators, eye protection, gloves, gown and shoe covers.	For the correct use of PPEs, just their availability in surgical care is not enough. Training routines for their correct use is necessary.
02	EVANS et al. / 2020(16) / PubMed	All surgical team involved: disposable cap, boot-shaped shoe protection, N95 masks, goggles or face shield, double sterile gloves, sterile gown and surgical mask over the N95 (in case of reuse of the N95).	They implemented a protocol for donning and doffing PPE and attached the form in the operating rooms and procedure areas, providing an additional safety measure for surgeons and staff.
03	BOZA et al. / 2020(17) / LILACS	Medical staff involved in surgical procedures must use N95/PFF2 masks, disposable shoe protectors, goggles or face shield, caps, double gloves and waterproof aprons.	They implemented a checklist for donning and doffing PPE for surgical procedures in COVID-19 patients.
04	ZIZZO et al. / 2020(18) / LILACS	All surgical personnel involved must wear appropriate PPE, i.e., a tested PFF2 mask, eye protection, double gloves, waterproof, double, and long-sleeved protective apron.	A negative pressure anteroom, with separate entrance that can be used for donning and doffing PPE is recommended.
05	COCCOLINI et al. / 2020(19) / LILACS	All surgical care professionals must wear complete PPE. PFF2/PFF3 masks, waterproof surgical coat, sterile gloves, goggles or face shield, disposable cap and shoe protection.	PPE must be removed and disposed of outside the operating room in exclusive containers, ensuring that the virus is not transmitted to the healthcare professional.

Table 3. Scientific articles included in thematic 1.

N	Author / year / database	Theme 1 - PPE necessary for the use by health professionals in the care of surgical patients in the context of COVID-19
01	LIANG et al. / 2020(20) / PubMed	They recommended the use of N95/PFF2 mask, face shield or goggles, cap, surgical gown and gloves for surgical care.
02	DING et al. / 2020(21) / LILACS	They recommended the use of cap, goggles, N95/PFF2 masks, waterproof aprons, shoe protectors, and double gloves with sterile disposable gloves in short duration surgeries.
03	SIMONE et al. / 2020(22) / LILACS	They recommended the use of N95/PFF2 mask, eye protection, cap, oversized long-sleeved waterproof apron, knee-length shoe protection, and a double pair of gloves for surgical care.
04	AL-JABIR et al. / 2020(23) / LILACS	Use PFF3 respirators and full gowns during aerosol generating procedures.
05	WONG et al. / 2020(24) / LILACS	They recommended the use of a N95/PFF2 respirator, face shield or goggles, disposable gloves and a splash resistant apron in surgical care.
06	HEFFERNAN et al. / 2020(25) / LILACS	They recommended the correct use of PPE, including a respirator or N95/PFF2 mask covered by a face shield during surgical care.

Table 4. Scientific articles included in thematic 2.

N	Author / year / database	Theme 2 - Conduct related to the use of PPE by health professionals in the care of surgical patients in the context of COVID-19
01	BENÍTEZ et al. / 2020(15) / LILACS	Implementing PPE donning and doffing protocols in the context of COVID-19 for surgical procedures.
02	BALIBREA et al. / 2020(26) / LILACS	Prior training in supervised PPE donning and doffing is required prior to performing a surgical procedure. PPE must completely cover the skin, especially high-risk body areas: nostrils, mouth and eyes.

DISCUSSION

Scientific evidence has emphasized the recommendations of using various PPEs for health professionals during the care of surgical patients in the context of COVID-19, including: the N95/PFF2 mask, face shield or goggles, long sleeve waterproof aprons, knee-length shoe protectors, cap and double gloves. Regarding conducts of the use of PPE by health professionals in the care of surgical patients in the context of COVID-19, the following were identified: previous training, protocols for putting on and taking off PPE and, checklist for donning and doffing PPE, and the importance of equipment covering the nose, mouth and eyes.

The Brazilian Association of Nurses in the Operating Room, Anesthetic Recovery and Material and Sterilization Center (Portuguese acronym *SOBECC - Associação Brasileira de Enfermeiros de Centro Cirúrgico, Recuperação Anestésica e Centro de Material e Esterilização*) emphasizes that care within the operating room units for patients with suspected or confirmed infection by COVID-19 must be based on the proper use of PPE by the entire team, including cap, waterproof apron or coat, goggles or face shield, respirator or N95 mask, which should cover eyes, nose and mouth, gloves that cover the apron cuff, closed and waterproof shoes that allow disinfection⁽⁷⁾.

The use of masks was highlighted during the COVID-19 pandemic, and the effectiveness of this equipment came into question among health professionals and patients, in addition to the awareness raised regarding the scarcity of this material. The surgical mask popularly used in patient care is recommended to protect against droplet transmission that can be generated from speech or cough (particles > 5µ microns), while the N95/PFF2 mask is limited to aerosol generating procedures (particles < 5µ microns)⁽²⁷⁻²⁹⁾.

In the context of surgical care in the midst of a pandemic in patients with suspected or confirmed cases of COVID-19, transmissibility is high given the numerous procedures performed in the intraoperative period that generate aerosols, from intubation, cauterization, need for resuscitation and extubation of the patient. Therefore, for the safe provision of surgical care with the lowest possible level of exposure of health professionals to contamination, the use of the N95/PFF2 mask is recommended concomitantly with the use of other PPE⁽⁷⁾.

Goggles or face shields are used when there is risk for contamination of the health professional, such as splashes, excretions and other fluids. Thinking in the context of COVID-19 and surgical care to patients in times of pandemic, if the choice is to use the face shield, it is recommended to cover the front and sides of the face and for exclusive use of the professional, requiring disinfection in every use with sodium hypochlorite or any other disinfectant recommended

by the equipment manufacturer or by the infection control service of the healthcare unit⁽³⁰⁻³¹⁾.

The use of the apron is extremely important throughout the management with a suspected or confirmed COVID-19 patient, and the National Health Surveillance Agency (ANVISA) emphasizes that waterproof aprons must contain a waterproof structure and a minimum weight of 50 grams per square meter (g/m²), be comfortable, hypoallergenic, without toxicity and provide an antimicrobial barrier. Waterproof gowns must be available in surgical units in different sizes and preferably disposable, if not, after use, they should be sent to a hospital laundry for processing⁽³⁰⁾.

The use of disposable shoe protectors is a routine within operating rooms (known as *propé* in Brazil). In times of the COVID-19 pandemic, some practices are addressed regarding the use of knee-length shoe protectors in surgical patient care to ensure health professionals' protection^(22,32). The Brazilian recommendations of bodies that regulate care practices in operating rooms, such as the SOBECC, highlight the importance of wearing fully closed, waterproof, disinfectable shoes, but they do not specify the use of shoe protectors⁽⁷⁾.

By knowing the purpose of using all PPE in the context of COVID-19, the cap should be used by health professionals in risky situations. Its main purpose is to act as a protective barrier for professionals against aerosol and droplets and the drop of hair strands generating contamination during surgical care⁽³⁰⁾.

The use of double glove is recommended in specific situations offering higher risk of contamination for health professionals during surgery. In recent studies on COVID-19, the literature recommends the use of this strategy during surgery for patients with suspected or confirmed cases⁽³³⁾. However, SOBECC and ANVISA do not support this indication in their recommendations for PPE use in the context of the COVID-19 pandemic^(7,30).

The simple supply of PPE quantity and quality is not enough for the protection of professionals from contamination by SARS-CoV-2. The Ministry of Health and ANVISA's technical notes recommend the promotion of education through training to all health service workers (own, outsourced and/or temporary), updating them on risk factors, instructions on which PPE to use in each situation, including respiratory protection devices, their correct placement, signs of damage or malfunction of the equipment before and during its use and, finally, its removal and proper, safe disposal^(30,34-35).

These notes also suggest that the training material should be easy to understand and always available. The performance of realistic simulations of critical situations is recommended for the minimization of stress with the possibility of reproducing possible scenarios, which can contribute to a higher safety of the team and patients in real care situations^(30,34-35).

SOBECC addresses the need for appropriate training in standard, contact, droplet, and aerosol precautionary techniques for teams working in the operating room, material and sterilization center, and endoscopy services. These measures should be taken together, aiming to equip and train professionals for the correct donning and doffing of PPEs, in addition to ensuring a continuous and close listening of professionals for assessment and embracement of doubts and difficulties in the proper use of each equipment^(7,34).

Thus, it is essential to implement protocols defined by the hospital's infection control together with the teams of the care units. Such protocols must be prepared and made available in writing, in accessible places, establishing rules and routines of procedures involved in donning and doffing PPE, advising health professionals on the correct sequence of these procedures, storage, integrity assessment, time of use and criteria for disposal⁽³⁶⁻³⁷⁾.

The proper use of PPE is essential to minimize the exposure of health professionals to SARS-CoV-2. The better the coverage the greater the safety, although an effective removal of all protective items is more difficult and at the time of doffing PPE that the contamination of professionals can occur^(36,37).

Authors suggest that training for donning and doffing should occur frequently, as they observed high contamination of professionals at the time of removal of PPE⁽³⁶⁻³⁷⁾. In addition, at the time of doffing, the supervision of health professionals by another professional, also trained, along with a PPE removal checklist are recommended, thereby ensuring the correct sequence and free from contamination of professionals⁽³⁸⁾.

Since there is no consensus on the recommendation of the place specifically reserved for the donning and doffing of surgical center professionals, there is a gap and lack of uniformity for the implementation of this conduct. It is advisable to indicate exclusive areas for this purpose with negative air pressure that provide a lower risk of contamination of health professionals⁽³⁹⁾.

As limitations of the present study, we emphasize that although most scientific articles included in the integrative review present level of evidence 1, there was a significant amount of levels of evidence 5 and 6 from case reports or experiences and expert opinions. This limitation of the level of evidence of studies may result of the theme addressed, since many published articles are experiences and expert opinions amid ideal and successful behaviors related to the COVID-19 pandemic.

CONCLUSION

The PPE required for surgical care to patients with a suspected or confirmed case of COVID-19 are: N95/PFF2

mask, face shield or goggles, long-sleeved waterproof aprons, knee-length shoe protector, disposable cap and double gloves. These PPEs have a relevant impact when it comes to the prevention and protection of occupational health in the context of care in the operating room.

The impact of behaviors related to the use of PPE that minimize the risk of contamination of health professionals were: training of the surgical team in handling suspected or confirmed COVID-19 patients, anteroom with negative pressure for donning and doffing PPE, implementation, training and checklist for donning and doffing equipment, and exclusive containers outside the operating room for disposal of PPE.

This study highlighted the types and relevance of each PPE, emphasizing the updates given the pandemic context experienced for the expansion of knowledge of health professionals providing care in the operating room, aiming at safety during surgical care to suspected or confirmed COVID-19 patients.

These findings contribute to help health professionals to protect themselves and choose the necessary equipment to offer care to COVID-19 patients. Thus, it is strongly recommended that all health professionals working on the front line of care for surgical patients with COVID-19 are safe to discern which PPE is ideal for this practice. Given the experienced context, good health safety practices for professionals working in the care of surgical patients with COVID-19 are necessary, as well as the development of care strategies based on institutional protocols.

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