Review

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Exploring the need for surgical face masks in operating room: a comprehensive literature review

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Abstract

Surgical face masks (SFM) are pivotal in preventing surgical site infections (SSI) in the operating room (OR). However, there are currently no specific recommendations for their most effective use. SFM effectiveness is influenced by factors such as material, fit, and duration of use, sparking ongoing debates about their benefits and risks in surgery. SFMs act as a protective barrier, but their ability to filter out harmful compounds is questioned. They can also impact communication and create a false sense of security. Nevertheless, SFMs aid in infection prevention and provide psychological comfort. Clear guidelines are needed to ensure their appropriate use in the OR. This paper offers a historical overview of surgical masks, emphasizing their role in infection prevention. It explores SFM effectiveness for both the surgical team and patients during surgery and considers their future in surgical settings. As we navigate the evolving landscape of SFMs, clear and concise guidelines are imperative to ensure their judicious and effective use in the OR. This paper serves as an essential resource for understanding the historical significance, contemporary efficacy, and prospective trajectory of SFMs in surgical practice.

Keywords: medical mouth–nose protection, operating room, personal protective equipment, surgical face masks, surgical site infection

Introduction

Infection control is a key element of healthcare, and reducing infection spread is critical for patient safety. Face masks have always played an essential role in illness protection in the general population, as seen by their growing popularity during the COVID-19 epidemic. Face masks are required for all healthcare personnel, particularly those in the surgical area. Surgical face masks (SFM) serve an important role in avoiding the spread of surgical site infections (SSI), which arise in the operating room (OR) due to infectious agent transmission and staff non-compliance with best practices[1]. Because of the prolonged time of postoperative hospitalization, greater risk of readmission, and additional surgical operations, SSI has a negative economic and financial impact[2]. Although SFMs are commonly utilized in the operating room, there are no clear guidelines on how to use them optimally, including the type of mask, duration of usage, and frequency of replacement. Compliance and proper utilization are the most crucial requirements for effective SFM[3]. Furthermore, the COVID-19 pandemic has renewed interest in the use of SFM

HIGHLIGHTS

- Infection control in healthcare: Infection control is a pivotal component of healthcare, and preventing the transmission of infections is imperative for ensuring patient safety. Surgical face masks (SFM) play a crucial role in mitigating surgical site infections (SSI) within the operating room (OR). Nonetheless, current guidelines for their optimal usage lack clarity.
- Factors affecting SFM effectiveness: SFMs act as a physical barrier, but their effectiveness hinges on various factors, including the material used, fit, and duration of wear. Concerns revolve around potential contamination filtration, bacterial shedding, and the deposition of skin scales.
- The evolving landscape of SFM: The landscape of SFMs is continually advancing, with ongoing discoveries in new technologies. Since their inception in 1918, SFMs have transitioned through numerous eras and will continue to evolve through further research and experimentation.

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and its usage in infection control. The pandemic has highlighted the necessity of respiratory protection for healthcare personnel, as well as the need to ensure that adequate personal protective equipment (PPE) is available throughout healthcare procedures. The existing data is broad, with many different types of masks, which adds to the confusion over which type to use and how to utilize them.

We chose this topic specifically to demonstrate the significance and proper application of SFM in the OR, not only for its routine use but also for the real benefits of disease prevention.

Historical overview of surgical masks

Throughout history, humans have been wearing face masks since the dawn of civilization. The earliest known masks were 9000-year-old Neolithic stone masks from Judea, possibly used as funerary masks by Neanderthals. In the 17th century, Venice was famous for its decorative carnival masks, but the most memorable Venetian mask was worn by medieval "Plague Doctors" to protect against the Black Death[4]. In modern medicine, the use of face masks has evolved over the years. In the mid-19th century, Semmelweis demonstrated the importance of handwashing in reducing infections in healthcare settings, especially maternity clinics. Despite his achievements, Semmelweis encountered resistance and skepticism from the medical community, and his concepts were not widely embraced in his lifetime[5]. This preceded the later work of Joseph Lister and Louis Pasteur, who hypothesized that wound diseases were mainly caused by the germs of microscopically small living entities. To prevent these infections, Mikulicz described a mask in 1897, composed of one layer of gauze, and its efficiency was later proven in 1918. These masks were first worn by the surgeon Paul Berger in Paris in the operating room and then used in the US and European hospitals. In 1918, Weaver reported that the incidence of diphtheria contracted by attendants of infected patients significantly decreased to zero after wearing masks with double-thickness gauze[6]. In 1919, he also found that the mask efficiency was directly proportional to the closeness of the mesh and increased the number of gauze thicknesses[6]. However, after the introduction of antibiotics in the 1940s for infection control, interest in the use of masks dropped.

Over time, antibiotics have shown no substitute for masks, and the latter were renewed in the late 50's. One-layer gauze masks were later proven to be of negligible effectiveness, indicating their improper fitting and poor bacteria filtering. In the next few years, masks have been produced to combine new deflection and filtration principles. Currently, masks are used worldwide to prevent infections during operations through proper filtering. Methods of evaluating SFM efficacy have emerged over the last decade, which help determine the best possible masks available, leading to a reduction in the rate of infection[6]. Currently, the novel coronavirus is writing an interesting new era in the cultural history of masks. During the pandemic, health authorities have recommended wearing SFM. Since then, SFM has been produced using different materials with different designs and techniques to improve their effectiveness[7].

Types of surgical face masks

Over the years, new designs and materials have been introduced to the mask industry, enhancing patient protection during surgery. Shielding the wound from pathogenic bacteria in the mouth and nose involves two different methods: filtering bacteria from the air passing through the mask or deflecting the expired air so that it travels behind the head. It should be noted that the efficacy of wearing masks depends on how well they fit to avoid air leakage from the edges[8]. Complications have been reported when wearing SFM for an extended time period, especially during the COVID-19 pandemic: headaches, confusion, nasal dryness, epistaxis, eye dryness, and skin reactions[9]. Currently, SFMs are produced using fabric-forming technologies: woven, non-woven, and knitted. Mask materials include (Fig. 1): cotton, polyester, polypropylene, polystyrene, polycarbonate, and polyethylene[8,10]. The filtration efficiency of SFM depends on the fiber selection, method of manufacture, web structure, and cross-sectional shape of the fiber.

The European standards and ASTM standards provide standardized quality evaluation procedures for SFMs, which include breathing resistance, splash resistance, bacterial filtration efficiency, and flammability. Most masks are made of non-woven fabric, which allows for better air permeability and higher bacterial filtration efficiency, thereby limiting the risk of contamination after use. Reusable woven and knitted masks must be washed and decontaminated after every use and appear less protective[10]. We identify MNP (Fig. 2) (medical mouth–nose protection) known as the "surgical mask". These masks are made of three layers of material, usually including an inner layer of non-woven fabric, a middle layer of melt-blown fabric, and an outer layer of non-woven fabric, filtering out ~70–80% of airborne partiles[11].

FFP2/3-mask (Fig. 3) (face filtering piece)/N95-mask, which has the same role as MNP, but they offer significantly better protection and reliability because they're designed to filter out at least 95% of airborne particles[12]. FFP2 masks, or N95 respirators, incorporate specialized materials for effective particle filtration and wearer comfort. Electrostatic non-woven fabric filters particles, while spun-bond polypropylene forms a liquid-resistant outer layer. Soft non-woven fabric lines the inner layer for comfort, and a flexible nose clip ensures a secure fit. Headbands or ear

Figure 1. Surgical mask product description example.

Figure 2. Surgical mask (MNP).

loops secure the mask, with optional foam for added comfort. These materials collectively meet regulatory standards for filtration efficiency and safety while ensuring wearer comfort and usability[13]. FFP3 masks, designed for even higher levels of filtration efficiency, employ similar materials to FFP2 masks but with enhanced capabilities. A valve on an FFP mask is an additional comfort feature that has nothing to do with the FFP protection level. It opens when you breathe out, and remains tightly closed when you breathe in. Warm and moist exhaled air is then conducted directly and unfiltered out of the respirator, while the high filter performance of the FFP mask is retained during inhalation[13]. The exhalation valve ensures a more comfortable climate inside the FFP mask and makes exhaling easier. FFP2 masks may be used with contaminant concentrations up to 10 times the workplace exposure limit (WEL). They protect against harmful water and oil-based particles. They don't protect against carcinogenic substances, radioactive particles, airborne biological agents of risk group 3 and enzymes. The total leakage of an FFP2 mask is a maximum of 8%. At least 94% of contaminants are filtered out of the inhaled air. Common applications for an FFP2 mask include handling softwood, metal, plastics (not PVC) and oil mist. While FFP3 masks may be used with contaminant concentrations up to 20 times the workplace exposure limit (WEL). They protect against harmful and carcinogenic water and oil-based particles, as well as radioactive particles, airborne biological agents of the risk group 2+3 and enzymes[13]. The total leakage of an FFP3 mask is a maximum of 2%. At least 99% of contaminants are filtered out of the inhaled air. Typical applications for an FFP3 mask are for example handling heavy metals, hardwood, brake dust, radioactive substances, pathogens such as viruses, bacteria and fungal spores as well as stainless steel welding[13]. The appropriate usage timeframe for FFP2 and FFP3 masks usually depends on the particular situation and directives outlined by health agencies or regulatory entities[14]. In healthcare environments or instances with significant exposure risks to pathogens, especially in pandemics, FFP2 and FFP3 masks are commonly advised either for one-time use or for a restricted period, determined by variables such as moisture levels, respiratory activity, and mask contamination[14]. Properly fitting face masks play a crucial role in protection, being even more significant than the filtration material itself. While N95 masks are capable of filtering over 95% of airborne particles, their effectiveness greatly depends on how well they are fitted. Improperly fitted N95 masks can result in particles leaking from the sides, making them no more effective than surgical or cloth masks in certain situations[15].

While having the best efficacy, FFP2/3 and N95 can be uncomfortable and cause breathing difficulties considering their dense structure, especially when wearing masks without valves[9,12]. Finally, deflection-type masks are face shields (Fig. 4) commonly used in conjunction with MNP and N95 masks, which protect the wearer's face from splashes, debris, and droplets of infectious materials[16]. They protect the patient by deflecting the air expelled by the wearer behind his head.

However, this did not reduce the bacterial count in the OR[8].

Figure 3. FFP (filtering face piece) mask with valve.

Figure 4. Face shield.

The visor also called a lens or window, is typically made of polycarbonate, and the frame is generally made of lightweight plastic. Although these shields are easy to use, they interfere less with breathing and are more comfortable, may cause visual strain due to glare or fogging, and their bulkiness makes them less practical for community use[16].

Evidence of the effectiveness of the surgical team

The use of surgical face masks was first supported in 1897 in a study published by Mikilicz, a German physician Mikilicz[8]. Since then, wearing surgical masks has been a mainstay in the world of medicine, and the verdict of actual benefits has been discussed, but no consensus has been reached yet. It is a popular belief in the surgical community that the use of face masks is favored because they convey a certain level of protection against patient-derived infections[17]. The main concern for the protection of the healthcare team is blood-borne infections[18]. Infections of the surgical team through blood-borne or airborne pathogens are preventable in 245 surgical procedures by wearing a face mask[19]. There has been no extensive research regarding the use of face shields alongside surgical masks to decrease the risk of communicating infections to patients. One article described a face shield as personal protective equipment that acts as a barrier to the facial area and associated mucous membranes from splashes and sprays of a patient's bodily fluid, conveying protection only to the individual wearing it. However, it does not reduce bacterial shedding from the surgeon or treating staff into the patient's wound[20].

The risk of contracting an infection in the surgical field decreases as the distance between staff members and the sterile field increases[21]. This stratified the team into high-, moderate-, and low-risk personnel. The leading surgeon is at the highest risk of contracting an airborne or blood-borne infection through inhalation or blood splashes. This necessitates wearing face masks. Other personnel at a lower risk were not studied.

Recommendations were made based on the risk of SSI for the patient, and staff safety was not well discussed[22]. Moreover, a newly conducted questionnaire-based study assessing surgeons' attitudes toward face masks showed valuable results. 96% of the responding physicians, 96% wore face masks; however, 20% wore them solely out of respect for tradition. The idea that wearing face masks increased the difficulty of surgical procedures by increasing breath condensation on endoscopes, spectacles, and microscopes, thus obscuring the surgeons' vision, was communicated by 30% of responders to this questionnaire[23]. In a systematic review conducted in 2020, it was recommended that a surgical mask is mandatory for scrubbed staff in implant surgeries, while it is only recommended for scrubbed staff in other types of surgery and non-scrubbed staff standing within 1 m of the wound in all surgeries. Insufficient evidence for surgical mask use was demonstrated for non-scrubbed staff standing within and more than 1 m of the wound in cases other than implant surgeries[24]. Anesthetists and other circulating staff in the operating room should continue to wear surgical face masks whenever there are open sterile items or instruments present.

Recent research suggesting the safety of "unmasked" circulators for patients has raised concerns. While the likelihood of infectious pathogen transmission from "unmasked" circulating staff to patients through their nasopharynx and oropharynx appears to be minimal, organized clinical trials must be conducted before contemplating any changes in current practices[25].

Even though there is insufficient evidence to support or refute the use of face masks, most surgeons prefer to keep a cautious approach to the matter and echo the recommendations of the National Institute for Health and Care Excellence.

Evidence of the effectiveness for the patient

The use of surgical masks in operating theaters is a longstanding practice that has not been reconsidered. However, the actual definite benefit to staff or patients has not been proven. The filtering effectiveness of surgical face masks cannot be measured using an identical method. Despite this lack of standardization, the majority of research has discovered significant variation in the commercial face masks' filtering effectiveness. The effectiveness of face masks, as measured by actual compliance with proper use, is far from ideal[25]. Several factors confer these benefits, which are discussed in terms of theory. Approximately 2.7% of all surgical procedures are complicated by SSIs according to the Centers for Disease Control and Prevention (CDC)[26]. SSIs are the leading cause of increased hospitalization duration, morbidity, and mortality in surgical patients. It is theorized that the prolonged use of face masks with continuous friction with the surgeon's face may lead to the shedding of skin scales that may fall into the patient's open wound owing to the proximity of the surgeon's head to the wound[27].

Another hypothesis suggests that the venting phenomenon leads to an increased risk of SSIs. The venting phenomenon occurs with prolonged usage of the same face mask. The longer the surgeons have the same mask on, the more moisture accumulates, which inhibits the ability of the filters to efficiently disperse breath. Extensive air leaks occur between the mask and face, which leads to a higher bacterial shedding load in the patient's field[28]. Several studies have failed to demonstrate a clear connection between face masks and surgical site infections. Analyses of studies that looked again at the link between surgical face masks and postoperative SSIs do not produce enough convincing evidence for physicians to stop using surgical face masks regularly. Just one recent article has disputed the widespread use of face masks. Swedish study seems to hold any kind of external credibility. More definitive research is required to validate such a conclusion before regular adjustments are evaluated[25]. In a systematic review conducted in 2020, it was recommended that a surgical mask is mandatory for scrubbed staff in implant surgeries, while it is only recommended for scrubbed staff in other types of surgery and non-scrubbed staff standing within 1 m of the wound in all surgeries. Insufficient evidence for surgical mask use was demonstrated for non-scrubbed staff standing within and more than 1 m of the wound in cases other than implant surgeries[29]. The Webster and colleagues study, a randomized controlled trial conducted in 2010, concluded that the infection rate in the unmasked group was 9.1% compared to 10.5% in the masked group. However, these differences were not statistically significant[26]. In another study published in 2013, there was a significant reduction in the bacterial count and increased patients' safety with mask-wearing surgical staff, but only in the first 30 min of mask usage. Bacterial counts were comparable in both masked and unmasked groups after 2 h of mask usage[30].

The final factor to be considered when weighing the risk-benefit ratio of mask usage in surgical sites is patient concern and emotional safety. It was shown that patient distress was significantly relieved when surgeons wore masks. Finally, it remains unclear whether the use of a face mask confers a definite benefit to either the patient or the surgeon. The National Institute for Health and Care Excellence guidelines assert that the use of masks contributes to the most important factor in the surgical theater discipline[31].

Factors affecting the effectiveness of surgical face masks in surgery

Several studies have identified surgical mask bioburden as the main cause of SSIs[32]. Factors contributing to the increase in the bioburden of surgical face masks could be divided into two main categories: how they are made and how they are used. Disposable single-use surgical masks are made from fine glass-fiber mats with a 1.5–2 mm thickness, which demonstrates the removal of up to 98% of bacteria or viruses from an aerosol (Fig. 5)[33]. However, if the mask is not well fitted to the surgeon's face, its effectiveness in filtering can be reduced anywhere between 5 and 40%. Furthermore, the duration of wearing a single mask is an important factor that should be discussed. Several aspects affected by the duration of mask usage have been studied, including the amount of bacterial shedding and the effectiveness of filtration. Several masks were sampled and colonized after wearing in increments of 30 min for up to two and a half hours. The plot showed a significant decrease in the average bacterial count to almost zero at 30 min compared to colonization without wearing a mask. However, the average bacterial count continued to rise exponentially after the first hour and a half to reach even higher averages than those colonized by the non-mask-wearing groups[30]. This indicates that masks are effective in filtration within a certain time limit. It is generally recommended by several studies that surgical masks be changed periodically during complex critical surgeries that span longer than two hours.

Risks and benefits of surgical face mask use in surgery

The debate regarding the use of surgical face masks in surgery is endless. Studies have not been clear-cut as to whether the benefits outweigh the risks or vice versa. Intuition drives many to believe that face masks are beneficial as protective barriers against droplets. However, this is not very accurate in all cases as it fails to protect the surgeon from many hazardous sub-micrometer contaminants and infectious organisms such as Streptococcus, Staphylococcus, and Hepatitis B[34]. Therefore, it is critical to note the type and size range of the contaminant when considering the protective role of face masks in surgery. In addition, venting may be an issue when wearing a face mask and could lead to the accumulation of moisture, which provides a nourishing environment for bacteria to thrive. Furthermore, skin scales can also be an issue when the face rubs on a mask, causing friction. This can be further exacerbated by facial hair and recent shaving[34].

It should be noted that using face masks in surgery can be a good standardization method that can contribute to and reinforce infection control practices. Moreover, face masks provide psychological comfort to both surgeons and patients concerning infection control. However, this can be a double-edged sword, as some surgeons fail to report certain exposure incidences owing to this false sense of security[35]. They may deem some exposure incidences as safe, as they are "protected" by the face mask, which may not always be the case because of the reasons mentioned previously.

Additionally, face masks can impair communication between healthcare professionals as they can muffle speech and mask facial expressions. This can be irritating for some surgeons working on urgent cases where every second is critical for the patient's survival and the surgeon's performance in the operation.

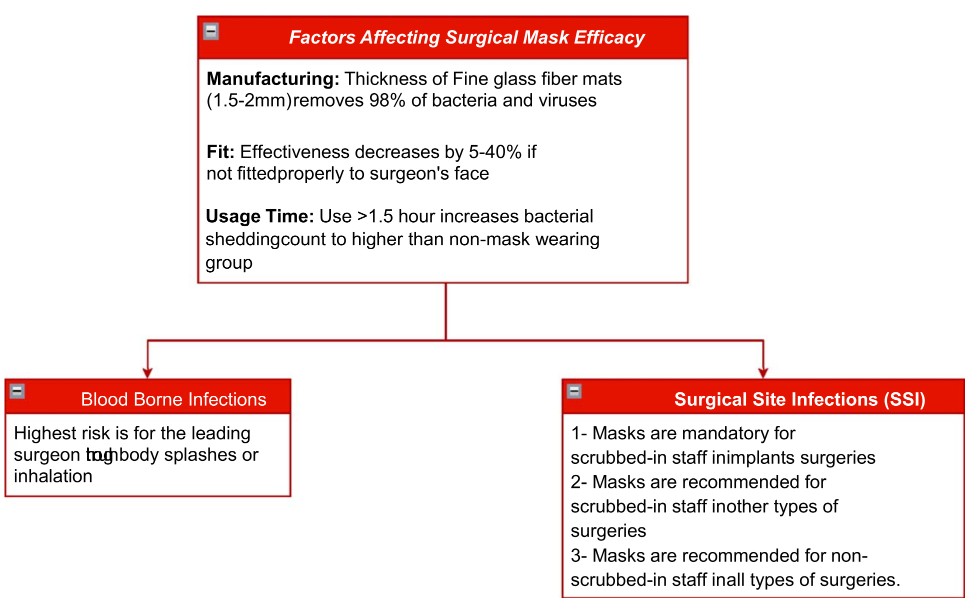

Figure 5. Factors affecting surgical mask efficacy[19,21,27,30].

Low-resource countries and the usage of masks during pandemics

The COVID-19 pandemic has exposed the difficulties faced by low-income countries in safeguarding their populations and healthcare workers. PPE, particularly face masks, is scarce in these countries and available only in a fraction of hospitals and clinics. This scarcity, combined with specific barriers such as occupational limits and dependency on public transit, impedes prevention efforts and contributes to a rise in transmission rates and fewer health outcomes[36]. According to research, mask use is more common among people with better socioeconomic class, with literacy rate being the most influential factor (Fig. 6). This emphasizes the need for education and health literacy in supporting behaviors such as mask use. However, one of the most significant barriers is the lack of affordable masks. Face masks are in high demand in low-resource countries, particularly in urban regions with vulnerable populations[37].

Another issue is the proper application and disposal of face masks. Inadequate disposal raises the danger of disease transmission, especially for waste pickers, scavengers, and children who may come into touch with discarded masks. Proper supervision and instruction on mask disposal are critical to preventing the virus and other microbes from spreading further[38]. Continuous public awareness efforts and training programs are required to educate populations on proper mask use, cleaning, and disposal. Furthermore, providing masks, soap, and hand sanitizers affordable or free can assist in overcoming resource limitations and promote fair access to preventive measures[38]. Because of resource constraints, reusing masks can reduce their effectiveness as barriers to viral transmission. This method may, paradoxically, increase infections, particularly in areas with high levels of antibiotic resistance[12]. Reusable surgical masks are also less effective in filtration and protection than disposable masks, and their effectiveness diminishes with each washing cycle[10].

To address these challenges, educational interventions such as instructive videos and training programs can improve awareness about the significance of wearing masks and taking other precautions. Furthermore, offering assistance in the form of low-cost or free masks, soap, and hand sanitizers can help overcome resource limitations and guarantee fair access to preventive measures[37].

Recommendations for surgical face mask use in surgery

The Centers for Disease Control and Prevention established guidelines for the concurrent use of masks in hospitals as a preventative measure to help in the prevention of transmissible illnesses among patients, surgeons, and surgical assistants in the operating theater from both identified and unknown sources[39]. This guideline is recommended to surgical practitioners, although the CDC acknowledges that there is little evidence regarding the efficacy of face masks against micrometer-sized contaminants and infectious particles[39]. This controversy has been recognized by other international guidelines. This led the CDC to propose certain strategies to reduce the incidence of SSI while considering several variables[39]. Primarily, they set a limit for the optimal wearing time of surgical face masks before they lose their bacterial filtration efficacy (BFE), which is up to four hours[40]. However, this guideline is limited to other variables, such as being within 3 m of the sterile zone, especially when the face is near the operative field and when dialogue between the surgical practitioners is expected[40]. In addition, when splashes of blood, bodily fluids, or other excretions are involved in surgery or if the patient is at risk of blood-borne infections, surgical face masks are recommended[40].

The CDC also encourages anesthesiologists to wear face masks when disinfecting and performing procedures in a completely sterile setting. Finally, the CDC requires surgical face masks to be the standard wear for patients[40]. Strategies to promote adherence to these guidelines are as follows: Initially, comprehensive education and training should be provided for all practitioners

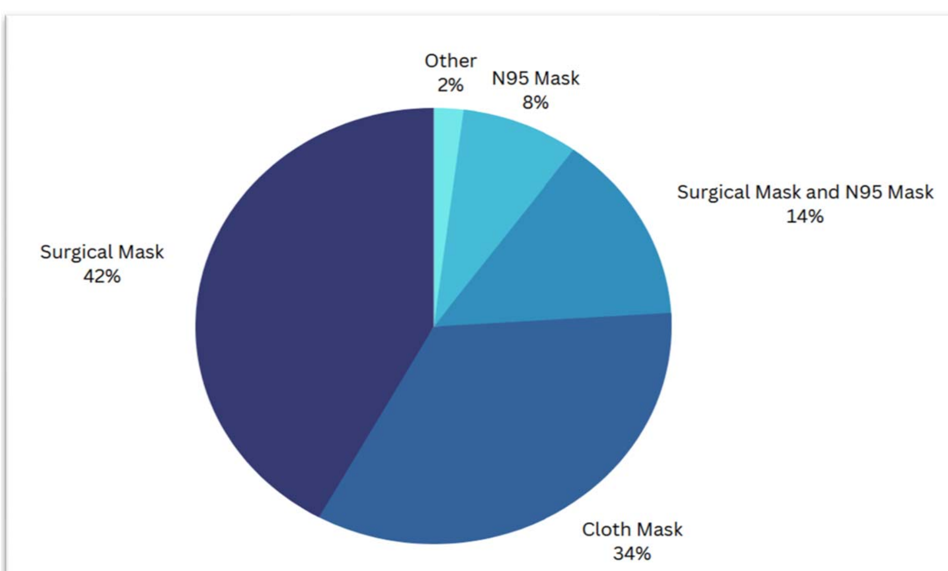

Figure 6. Percentage of distribution of various types of masks used by people.

involved in the operative field. As well as ensure that they realize the significance of abiding by the guidelines and using the right technique of wearing and disposing of the mask. Visual remin ders, posters, conferences, and e-mails can also help spread the word and reinforce the message. Moreover, it is important to supply sufficient face masks to meet the demands of surgeons during surgery. Finally, adherence to these guidelines should be accompanied by frequent monitoring and staying up-to-date with the latest guidelines.

Future of SFM use in surgery

"A mask may be repeatedly washed and used indefinitely ": that's how researchers in 1918 envisioned the future of surgical masks in surgery[7]. To this day, this sentence piques the curiosity of researchers; was that the future of SFM?

Currently, new emerging technologies are being implemented to enhance the efficacy of SFM. SFM might not be washed and reused but might be able to protect against exposure to light. This is possible because of the presence of photosensitizers (PS)[41,42]. After exposure to light in the presence of oxygen, PS can produce reactive oxygen species (ROS) by capturing the energy of light and transferring it to ROS[41,42]. These ROS are capable of killing cells and can be utilized as therapeutic agents in the treatment of certain skin and eye illnesses as well as certain types of cancer[41,42]. Hence, the antimicrobial properties of these PS materials are being developed as a promising technique to pro vide more effectiveness to SFM, and thus, more protection[41,42]. Research has explored adding ROS generators to masks to detect and neutralize inhaled bacteria and viruses, thereby reducing lung infections[41,42]. Simply altering the fabric with a positive charge and adding PS is not sufficient to make the fabric antiviral[42]. Therefore, further refinement is required. Another promising approach is the use of graphene. Zhao and colleagues applied graphene oxide (GO) to cotton fabrics using three methods to create antiviral masks[42]. However, upon washing these masks, removing GO from the fabric, depending on the method of pro duction, renders them ineffective[42].

Another innovative and highly effective approach involves the use of germicidal ultraviolet rays, particularly in regions with limited resources and scarcity of available masks[43]. Multiple studies conducted in Belgium have provided valuable insights into the practicality and efficacy of various decontamination methods, including Ultraviolet (UV) rays, to mitigate the transmission of norovirus via contaminated personal protective gear such as face masks and filtering respirators[44]. Given the significance of safely reusing masks and filtering face piece respirators (FFRs), both during the ongoing COVID-19 pandemic and in the future, where factors such as cost-effectiveness, environmental impact, and logistical considerations emphasize the importance of sustained decontamination of these previously single-use items, additional research is planned[43]. This study aims to explore the extent to which these formerly disposable items can be safely subjected to decontamination cycles[43]. Another noteworthy advantage of ultraviolet germicidal irradiation (UVGI) over chemical disinfec tion methods is the minimal or absence of chemical by-products remaining on the surface of single-use PPE after the sterilization process[45].

The future of SFM is in continuous progression, with new technologies and compounds discovered each day. SFM has evolved through various eras since 1918 and will continue to do so with additional research and experimentation.

Conclusion

In conclusion, Even though there is insufficient evidence to support or refute the use of face masks, most surgeons prefer to keep a cautious approach to the matter and echo the recommendations of the National Institute for Health and Care Excellence. Their historical evolution has shown their importance in infection control. However, there are still debates over their best use and the potential drawbacks. While SFM serves as a physical barrier, its effectiveness is determined by factors such as material, fit, and duration of usage. There are concerns about the filtration of hazardous contaminants, bacterial shedding, and skin-scale deposition. SFM, however, continues to be a crucial part of infection control procedures and supports the psychological well-being of both medical staff and their patients. It was shown that patient distress was significantly relieved when surgeons wore masks. To ensure its appropriate and effective use, clear guidelines are required. These guidelines should address issues such as proper mask selection, fit testing, duration of use, and the need for additional protective measures. Further research is required to establish standardized protocols and to assess the long-term effects of SFM use in the OR.

Summary

The significance of SFMs and PPE in safeguarding healthcare workers has been highlighted by the COVID-19 epidemic. Despite being widely used, there are no precise recommendations for the type, duration, and frequency of replacement of SFMs. SFMs, which include knitted, non-woven, and woven textiles composed of different polymers, are divided into groups according to their design and material. They work by deflecting or filtering outgoing air. Diverse mask varieties, including FFP2/N95 and FFP3, provide differing degrees of protection. The use of SFMs to shield surgical teams from infections—particularly blood-borne pathogens—is supported by research. The majority of surgeons continue to utilize SFMs because of their protective benefits, despite some disagreement. Analyses of studies that looked again at the link between surgical face masks and postoperative SSIs do not produce enough convincing evidence for physicians to stop using surgical face masks regularly. Studies with conflicting results have made it impossible to definitely confirm a link between SFMs and lower rates of SSI. Although there is a theoretical advantage to masks as they stop bacteria from shedding into surgical wounds, their practical effects differ. Disposable single-use surgical masks are made from fine glass-fiber mats with a 1.5–2 mm thickness, which demonstrates the removal of up to 98% of bacteria or viruses from an aerosol. However, if the mask is not well fitted to the surgeon's face, its effectiveness in filtering can be reduced anywhere between 5 and 40%. Long-term mask use may enhance bacterial shedding because of moisture accumulation, Several masks were sampled and colonized after wearing in increments of 30 min for up to two and a half hours. The plot showed a significant decrease in the average bacterial count to almost zero at 30 min compared to colonization without wearing a mask. However, the average bacterial count continued to rise exponentially after the first hour and a half to reach even higher averages than those colonized by the non-mask-wearing groups. This indicates that masks are effective in filtration within a certain time limit. Wearing a mask also contributes to the psychological comfort of patients, it was shown that patient distress was significantly relieved when surgeons wore masks. For bacterial filtration to be successful, single-use masks with fine glass-fiber matting must fit well. Extended usage leads to moisture buildup, which reduces filtration performance. It is advised to change the mask frequently during lengthy surgeries in order to preserve effectiveness. Evaluating the pros and cons of using SFM in surgery is at the heart of the discussion. Although masks offer a barrier of protection, they might not be completely effective against all toxins and can be uncomfortable and interfere with communication. Notwithstanding these difficulties, SFMs provide patients and surgeons with psychological comfort and simplify infection control procedures.

The continuous growth of SFMs is highlighted by historical advancements, contemporary methods, and upcoming innovations. SFMs' protective advantages for surgical teams and patients will increase with their appropriate use, resolution of issues, and adoption of new technologies.

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Author contribution

J.K.: design, literature review, writing, editing, and proofreading. M.A.: design, literature review, writing, and editing. K.Z.: literature review, writing, and figures. Y.S.: literature review, writing, and figure. H.O.: literature review and writing. I.N.: guidelines and risk management input, review, and proofreading. M.B.O.: infectious diseases input, review, and proofreading. M.M.: review, and proofreading.

Conflicts of interest disclosure

The authors declare no potential conflicts of interest for this work, or with respect to the research, authorship, and/or publication of this article.

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