

## Surgical Masks: The Hoax & the Truth

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**Abstract:** Surgical mask (a.k.a. Surgical face mask/Medical mask) is one of the most commonly used personal protective equipment (PPE\*) in the health care settings. Frequent epidemic outbreaks made awareness among the public regarding the importance of wearing a mask or face coverings. Though the surgical masks are widely used, a better understanding of its basic properties and usages will help anyone to make use of it properly. This article is an attempt to find out the hoax and truth regarding the surgical mask.

**Key Words:** Surgical mask, PPE, Epidemic.

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### I. Introduction To Surgical Mask

The surgical face mask is produced using fabric making technology. Even though there are three fabrics forming technology (Woven, Non-woven and Knitted), currently, most of the surgical face masks are made up of non-woven by using SMS\* (Spunbond Meltblown Spunbond) technology with a view of discarding of after use.<sup>1,17</sup> As SMS material can be treated with additional repellents to withstand for example alcohol, oil and blood, this makes it an outstanding fabric for the medical industry. Typically used to make Masks, gowns, sterilisation wraps, surgical drapes, disposable patient sheets, female sanitary products, nappies and incontinence products.<sup>17</sup> Polypropylene, polyethylene, polyester polystyrene, polycarbonate etc. are suitable for manufacturing surgical face masks. The surgical face masks are produced in different sizes like 14.5 X 9.5 cm for a child, 17.5 X 9.5 cm for adult, use and 12 X 7 cm for infants. They are available in multicolours like white, blue, green, yellow and pink.<sup>1</sup>

As per international standard ASTM F 2100-07\*, surgical face masks are largely classified into 3 types. They are i) Low barrier, ii) Moderate barrier and iii) High barrier. The basic features to distinguish the surgical face masks based on its barrier properties which are listed in Table 1 (ASTM F 2100, 2007\*).<sup>1</sup>

**Table 1. Classification of medical face masks based on its barrier properties.**<sup>1</sup>

Sl. No	Quality evaluation characteristics	Surgical Face Mask		
		Low barrier	Moderate barrier	High barrier
1.	Bacterial filtration efficiency (%)	≥95	≥98	≥98
2.	Differential pressure (mm H <sub>2</sub> O/cm <sup>2</sup> )	<4.0	<5.0	<5.0
3.	Sub-micron particulate filtration efficiency (%)	Not required	≥98	≥98
4.	Resistance to penetration by synthetic blood (minimum pressure in mm Hg for pass result)	80	120	160
5.	Flame spread	Class 1	Class 1	Class 1

Groupings of surgical face masks as per BFE\* in European standard EN 14683\* is as follows:<sup>1</sup>

- A. BFE ≥ 95%: indicates the Type-I surgical face masks
- B. BFE ≥ 98%: indicates the Type-II surgical face masks.

Groupings of surgical face masks based on splash resistance in European standard EN 14683\* are as follows:<sup>1</sup>

- A. For Type-I and Type-II surgical face masks, this test is not applicable.
- B. For Type-IR and Type-IIR surgical face masks, the specimen should be tested under the constant velocity of 120 mm Hg.

## **II. The Recommended Criteria For The Surgical Mask**

As per National Centre for Disease Control, DGHS, Indian Ministry of Health and Family Welfare, a surgical mask should be Triple Layered, Tie on Mask of Non-woven fabric material, Hypoallergenic 3 ply construction with the filter in between and with 4 tie strings.<sup>5</sup> Fluid resistant Type IIR, or ASTM F2100\* level 2 or level 3, or corresponding surgical mask is recommended by many organization like WHO.<sup>6,8</sup>

The terms 'fluid-resistant' and 'fluid-repellent' are frequently used interchangeably to represent a Type IIR surgical mask, which might not appropriate to denote its category. Because a 'fluid repellent' mask may occasionally describe a mask that does not meet the BS EN 14683\* splash resistance criteria and which is not suitable for protection against splash or spray i.e. a Type II surgical mask.<sup>8</sup>

When we wear a surgical mask or a respirator the infiltration of an environmental particle can occur in two ways, through the filter medium within the mask and face seal leakage. As most of the environmental particles penetrate via face seal, the priority in the development of a respirator or a mask should be shifted from improving the efficiency of the filter medium to establishing a better fit that would eliminate or minimize face seal leakage especially the surgical mask.<sup>18,19,23</sup> Control of exhaled particles attained with a surgical mask worn at the source, attains far greater levels of protection than an N95 respirator on the recipient. This shows the importance of respiratory source control in dropping exposure risk.<sup>19,20,21</sup> Wearing more than one mask at the same time does not give added protection and is not recommended.<sup>6</sup>

In concise fluid-resistant Type IIR, Triple-layered surgical mask with the filter in between, designed to provide optimum face seal should be used to get sufficient protection from the droplets and splashes. Surgical mask plays a major role in controlling the source of infection rather than protecting the recipient.<sup>20,21</sup>

## **III. The Purposes Of Wearing Surgical Masks**

The base for the use of surgical face masks is twofold. one is to protect the wearer from sources of infection e.g. splashing or spraying of blood and second is to protect others from the wearer as a source of infection.<sup>8</sup> Even though surgical mask with filter layer may be suitable to remove bacteria exhaled or expelled by health care workers, they may not be adequate to remove the submicrometer-sized aerosols containing pathogens to which the health care workers are possibly exposed.<sup>2</sup>

WHO\* guidelines for health workers to wear the mask in the scenario of the Covid-19 outbreak is as follows,

1. Wear a surgical mask when getting in a room where patients suspected or confirmed of being infected with 2019-nCoV are admitted and in any situation of care provided to a suspected or confirmed cases;
2. Use a particulate respirator at least as protective as a US National Institute for Occupational Safety and Health (NIOSH\*)-certified N95, European Union (EU) standard FFP2, or equivalent when carrying out aerosol-generating procedures such as cardiopulmonary resuscitation, non-invasive ventilation, tracheotomy, tracheal intubation, manual ventilation before intubation, and bronchoscopy.<sup>3,7,25</sup>

WHO\* also recommends that in community, the individual without respiratory symptoms need not wear a medical mask, as no evidence is available on its usefulness to protect non-sick persons.<sup>3</sup> Wearing masks when not required may cause pointless cost, procurement burden and create a false sense of security that may lead to neglecting other important measures such as hand hygiene practices.<sup>3</sup> In context of Covid-19, CDC recommends the public to use cloth face coverings in situations where social distancing measures are difficult to follow to slow down the spread of the virus and help people who may have the virus and do not know it from transmitting it to others. It also recommends that face coverings should not be used in children under 2 years and in one who is having trouble breathing.<sup>26</sup>

Hand hygiene is an important aspect of infection control that one should take care of before and after wearing a surgical mask. Wash hands with soap and water for at least for 40 seconds or make use of alcohol-based hand sanitizer with 70% alcohol at least for 20 seconds should be practised frequently. If hands are dirty or soiled, do not use alcohol based hand sanitizer, instead, wash hands with soap and water.<sup>9</sup>

A surgical mask, if properly worn, will be effective for up to 8 hours. If it gets wet in between, it needs to be changed instantly.<sup>4</sup>

The used mask should be considered as possibly infected. During home care, Masks used by patients/caregivers/ close contacts during home care should be disinfected utilizing sodium hypochlorite solution (1%) or ordinary bleach solution (5%) or appropriate concentration of Quaternary ammonium household disinfectant and then disposed of either by burning or deep burial.<sup>4,5</sup> In community settings, it may be disposed

of either by burning or deep burial.<sup>5</sup>In the health care settings,it should be disposed of in the identified infectious waste disposal bag/container (Yellow) using appropriate biomedical waste management practices.<sup>5,16</sup>

#### IV. Structural Significance Of Surgical Masks

Most of the standard surgical masks (Fig.1) have a three-layer design (though there are single and double-layered masks available without filter,it is not recommended to be used in the health care settings.<sup>5,10</sup>) which includes an outer fluid-resistant layer, an inner moisture-absorbing layer, and a middle layer which serves as a barrier to germs (filter). Wearer should follow the manufacturers’ recommendations when using surgical masks (e.g. determine which side of the mask is facing outwards or inwards). In general, the coloured side, the side with folds facing downwards of the surgical mask should face outwards with the metallic strip uppermost.<sup>10</sup>For masks without a coloured side, the side with folds facing downwards should face outwards.<sup>4</sup> There may be surgical mask available in the market with a non-coloured fluid-resistant layer which should be facing outward when wearing it.( I tested the same with 5 ml of tap water and found that the coloured layer was not fluid-resistant but on the non-coloured layer it was. Fig.2).So the coloured side of a surgical mask cannot be trusted always as a way to identify the fluid-resistant side, Instead, it is always better to follow the manufacturers’ recommendations when using a surgical mask. If manufacturers’ recommendations are not available with a surgical mask, I think the side with folds facing downwards should face outward.

#### V. Difference Between The Surgical Mask And The Respirator

The surgical masks are principally designed to protect the environment from the wearer, whereas the respirators are made-up to protect the wearer from the environment.<sup>22</sup>

**Table 2.Comparison of the respirator and Surgical mask.<sup>11-15</sup>**

Respirators	Surgical Masks
<ul style="list-style-type: none"> <li>It can be fitted tightly to the face, giving sufficient face seal, with two head straps and an adjustable clip over the nose to allow for a more custom fit.</li> <li>Filter particles from the air when appropriately fitted, helping reduce the number of particles or germs the wearer breathes in.</li> <li>Ideal for protection from airborne hazards like PM2.5*and Words like EN / NIOSH / ISI and the approval type (i.e. N95; FFP1* etc.) printed on the product.</li> </ul>	<ul style="list-style-type: none"> <li>Usually do not fit tightly to the face and can not provide complete face seal as there might be gaps around the edges.</li> <li>Prevent large particles expelled by the wearer when coughs or sneezes to spread into the environment.</li> <li>Not designed to protect your lungs from airborne hazards like PM2.5*and do not have the word NIOSH / EN / ISI and the approval type (i.e. N95; FFP2* etc.) printed on the product.</li> </ul>

The similarity of the surgical mask and the respirator is both can reduce the wearer’s risk of exposure to large droplets and body fluid splashes in the health care settings.

#### VI. Conclusion

The primary purpose of wearing the surgical mask is to protect the environment from the affected person or to control the source of infection.Therespirators like N95 should be used to protect the unaffected person from the high-risk environment where there is a chance of aerosol formation. Both play their own role in preventing the spread of contagious infections if it is properly used and discarded as per the manufacturer’s instructions. One should also practise frequent hand hygiene, use of other PPE\* along if required,IPC (Infection Control & Prevention) measures, maintaining at least one-meter safe respiratory distancefrom others and good respiratory etiquettes as these are as important as wearing a mask. The health care professionals especially nurses should emphasize to practice these measures among team members, patients and caregivers.

#### ABBREVIATIONS

ASTM-ASTM International, formerly known as American Society for Testing and Materials, is an international standards organization that develops and publishes voluntary consensus technical standards for a wide range of materials, products, systems, and services.

BFE- Bacterial filtration efficiency.

CDC- Centres for Disease Control and prevention. <https://www.cdc.gov/>

European standard EN 14683-This European Standard specifies construction and performance requirements, and test methods for surgical masks.

FDA-The Food and Drug Administration (FDA or USFDA) is a federal agency of the United States Department of Health and Human Services, one of the United States federal executive departments.

FFP1/ FFP2-filtering facepiece score comes from EN standard 149:2001

NCDC-National Centre for Disease Control (formerly known as the national institute of communicable disease).-<https://ncdc.gov.in/>

NIOSH-National Institute for Occupational Safety and Health.

OSHA-Occupational Safety and Health Administration.

PM 2.5 - refers to atmospheric particulate matter (PM) that have a diameter of less than 2.5 micrometres.

PPE- Personal Protective Equipment “specialized clothing or equipment worn by an employee for protection against infectious materials” (OSHA).

SMS:SpunbondMeltblownSpunbond, commonly known as SMS is a tri laminate non woven fabric. It is made up of a top layer of spunbond polypropylene, a middle layer of melt-blown polypropylene and a bottom layer of spunbond polypropylene.<sup>17</sup>

WHO- World Health Organization.

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Figure 1. Separated layers of Standard triple-layered surgical mask showing coloured outer fluid-resistant layer and inner non-coloured moisture-absorbent layer.

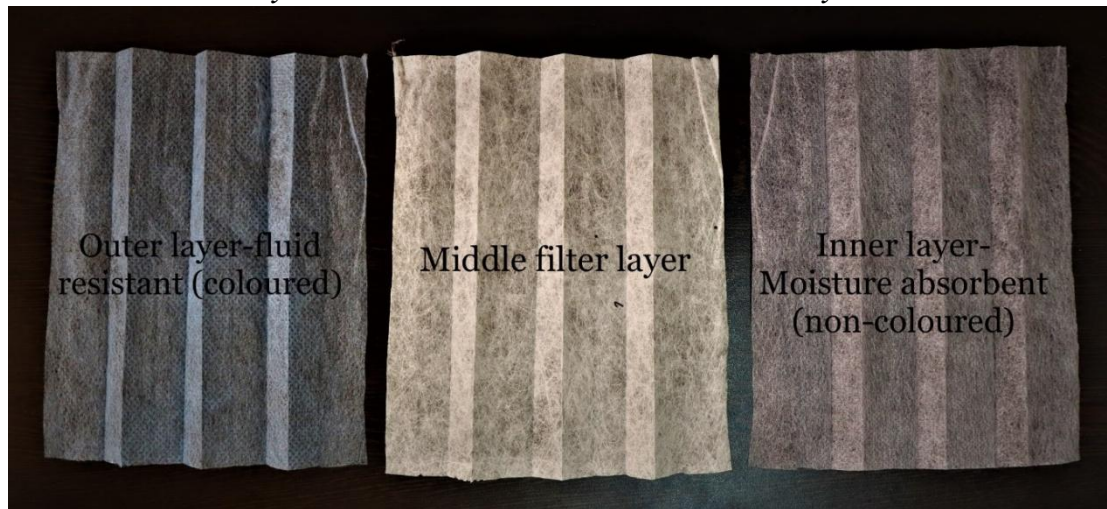
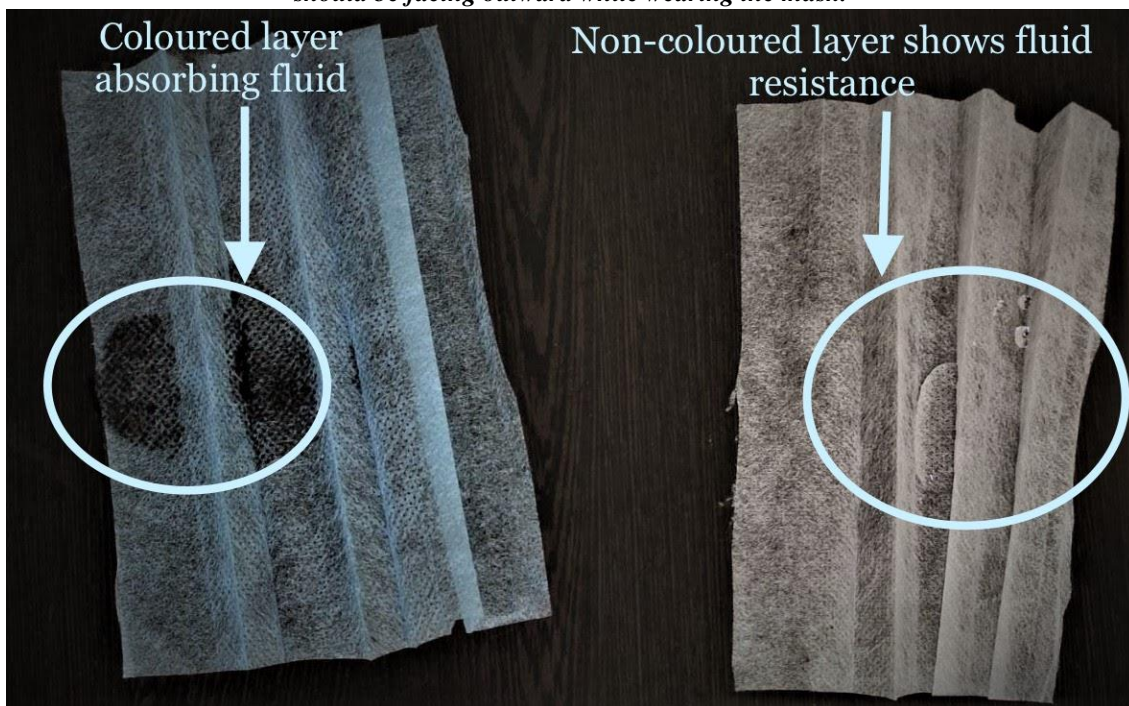


Figure 2. Separated layers of Standard triple-layered surgical mask showing non-coloured fluid-resistant layer and coloured moisture absorbent layer. Middle filter layer not shown. In this case, the non-coloured layer should be facing outward while wearing the mask.



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