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COMPOSITION AND USES OF N95 MASKS -A REVIEW

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ABSTRACT:

The key aim of this article is to provide a description of the structure and uses of N95 mask that is necessary to advance Personal Protective Equipment (PPE) during this COVID19 pandemic. Examples of personal safety gear designed to shield the user from infectious debris and from fluids contaminating the skin include the N95 respirators and medical masks (skin covers). A commercially available N95 respirator needs a suit factor of one hundred within the work-place to be deemed adequate. While we did not subjectively locate the respiration function needed with the prototype masks to vary from that necessary with a standard N95 filtering face device, this mask should not be used by people with respiratory risk of any sort. Although testers wear the masks easily for an hour, at any point in strenuous work or adverse environmental environments we can not think about their usefulness. This review offers detailed knowledge and appreciation of the structure, applications of N95 masks and, in turn, the advantages of N95 masks over other forms of surgical masks. Limitation and prospective range of the research were also addressed, as this subject is necessary to advance PPE in this COVID19 pandemic. This research contributes greatly to learning about the composition and uses of N 95 masks, and also helps to educate and make the general public informed of the critical role of N 95 masks during this pandemic assault.

KEYWORDS:

Composition, N95 masks, Personal protective equipment, respiratory protection, SARS-CoV-2.

INTRODUCTION

The Personal Protection Equipments (PPE) are used to shield the user from infectious contaminants and from fluids contaminating the skin including N95 respirators and medical masks (facial masks) (Benson, Novak, and Ogg 2013). N95 respirators are also supervised by the National Institute for Occupational Health and Safety (NIOSH), occupational safety and health Administration (OSHA) and Centers for Disease Control and Prevention (CDC) (Bałazy et al. 2006). The World Health Organisation suggests disposable gear like masks (if not appropriate, a fabric to shield the mouth is suggested) for people in areas plagued by multiple contagious diseases who have to treat people who are sick or infected (Ravichandran and Brundha 2016). Quality market masks are often not available, but inconsistent data has shown that homemade cotton gauze masks were secure during the Manchurian epidemic in military barracks and in healthcare professionals (Mitchell and Hunt 1991).

If professional masks are not affordable, a plain, locally produced, reusable mask may be a solution (Oberg and Brosseau 2008). The cloth used for producing it was heavy-weight T-shirts identical to the 2-ply battle dress uniform T-shirts used during the mouse tests for safety masks against ricin and saxitoxin (Tunevall 1991). Previously, templates and T-shirts were tested using a condensed version of a comparative Bitrex match check. The good ones were evaluated using the Portacount Plus Respirator Fit Tester with N95-Companion, a regular standardized fit check (Qian et al. 1998). Ineffective findings from initial quantitative fit tests on early designs lead to four layers of material being applied to the simplistic mask configuration. This mask is considered as a test mask (Martin and Moyer 2000). A 100% preshrunk Hanes Heavyweight cotton T-shirt (manufactured in Honduras) was heated with water for 10 minutes and air-dried to reduce shrinkage and the item was sanitized in a way that could be used in the developing nations. Using a scissor, marker and ruler, one outer layer (almost 72 cm) and eight inner layers (< 18 cm2) were trimmed out. And instantly, they would be organised, installed and fitted with the cap (Garner and the Hospital Infection Control Practices Advisory Committee 1996).

A fit factor is the number produced by replicating occupational tasks (a sequence of tasks, each 1 minute in length of time) during quantitative fit tests. The Portacount Plus Respirator Suit Tester used during the study with N95- Companion is an atmospheric aerosol device that tests the intensity of aerosols externally and within the sample mask (Brosseau, McCullough, and Vesley 1997). The demanding agent used is the tiny atmospheric particles as well as other aerosols found in the environment. An N95 respirator that is currently accessible needs a suit rating of 100 to be deemed acceptable in the workplace. The model mask with a Los Alamos National Laboratory (LANL) board face size of 4, a typical size, has attained a fit factor of 67 for 1 person. This mask, while inadequate for the office, provided considerable protection against the threatable aerosol and demonstrated strong fit with limited exposure (Han and Don-Hee 2000). The other two writers of LANL face size 10, the highest dimension, obtained fit factors of 13 and 17 by having the inner layers of the sample mask a little wider (22 cm2).

Instead of a correctly designed standard respirator we will not support the usage of this respirator. While consciously, the airflow function needed with the model mask to be unique from that necessary with a normal N95 filtering face device was not considered, this mask should not be used by individuals with respiratory vulnerability of any kind (Brundha, Pathmashri., and Sundari 2019). Whereas developers wore the mask without complexities for an hour, all through intensive activity or environmental stresses were found, we cannot remark on its effectiveness (Kumar and Brundha 2016). And thus the hand-made mask will have a decent match and a tangible degree of safety against an aerosol threat. Our main purpose of this study is to provide an overview about the composition and uses of N95 mask which serves to be mandatory for the advancement of Personal Protective Equipments (PPE) during this pandemic COVID19.

MATERIALS AND METHODS

An analysis was conducted to explain the composition and applications of N 95 masks by downloading a maximum number of relevant papers from different search engines such as pubMed , Google Scholar, MeSH, Core, Cochrane, bioRxiv, Textual Scholar and so on. Using the selection method in five steps such as identification of specific targets, identification of related posts, collection, data extraction & charting, review and reporting was finally produced. Taking into consideration the inclusion criterion are the papers relevant to the composition of N 95 masks, their application, their impact against airborne virus and also on the distinctions of N95 masks from other masks. Articles not related to N95 masks were excluded for the reference of this article.

COMPOSITION OF N95 MASKS

The N95 surgical respirator is plain-folded and extensible into a convex shaped cover including elastic head clips of polyamide / spandex to attach the mask to the neck of the patient, and a malleable aluminum strip located just above nose for a closer fit across the ears and nose (Qian et al. 1997). The respirator comprises four layers of plastic: an exterior layer of spun-bond polypropylene, a second layer of cellulose / polyester, a third layer of melt-blown filter material and an inner (fourth) layer of spun-bound polypropylene. A malleable band of aluminum located over the nose for a closer bond across the face and ears (Reponen et al. 1999).The external functional layer of the respirator is reinforced with a hydrophilic plastic film (primary substance: citric acid 2% w / w, pH-lowering entity) and a second inner layer filled with metal ions (inert ingredients: copper 1.6% w / w and zinc 1.6% w / w, creating ionic links with negative-loaded links) (Wang et al. 1999).

The N95 respirator model 's third layer has increased purification requirements (i8g / m2 meltblown polypropylene raised to 50g / m2 meltblown polypropylene) to reach the NIOSH Respirator Quality criteria (Hogan, Lee, and Biswas 2004).It was previously certified as biocompatible through allergy and sensitization monitoring, and toxicological examination of the drug ingredients subsequently emitted through inhalation or salivary exposure, which suggests that the face mask which respirator devices are suitable to be used in the expected formulation. This has an exhalation aspect that allows us to breathe and heat and moisture build up. This needs fit testing so that it can be calibrated to have the desired potency of sorting 95 percent pollutants as well as 0.3 micrometer mass median diameter particles (Bessesen et al. 2013). It does not contain any materials composed of organic latex rubber and its total weight was estimated to be 0.35 oz (Figure 1). This N95 mask is therefore composed of a quality mesh of artificial polymer matrix or non-woven polypropylene fibers created by the melt blowing process, which forms an internal purification membrane that separates out dangerous particles (Harsha and Brundha 2017).

EFFECT OF N95 MASKS ON DISEASE CONTROL AND PREVENTION

The N95 respirator is built to eliminate particular diseases or pathogens, and is branded or else can be described as filtering surgical fumes / droplets, filtering different quantities destroying virus or bacteria, reducing the quantity of virus , bacteria or fungi slaughtering, or influencing allergenicity (Banach, Bielang, and Calfee 2011). Either the external and second inner layers are handled with specific substances that inhibit the activity of viruses individually by multiple modes of action , for example, this concept is perhaps the most powerful prevention method to inhibit the activity of influenza viruses (Wise et al. 2011). In fact, it inactivates 99.99 percent of the influenza viruses examined in laboratory (in vitro) experiments on five minutes of interaction with the respiratory surface against the preceding natural, pandemic, avian, swine and equine influenza viruses, which comprises most of its various forms, such as Influenza A subtypes and HINI strains. Consequently, this kit is meant to be worn at periodic pandemic influenza A or influenza B(McKenna et al. 2013).

The anti-viral / anti-influenza materials used throughout the N95 surgical respirator's top two active layers are remarkably similar with those presumptive products licensed by FDA. N95 respirators are built to be used in a health-care environment. Primarily, single-use, portable respiratory protection products utilized and used by healthcare workers during operations to shield all patient including patients with Diabetes Mellitus (Preethikaa and Brundha 2018) and other immunocompromised individuals and health care employees from the movement of microbes, bodily fluids, and particulate matter. These N95 respirators are FDA controlled Class II products, under 21 CFR 878.4040, and NIOSH CDC products under 42 CFR Section 84 (Gralton and McLaws 2010).

For certain people with breathing issues, this mask creates a close cover around the mouth and nose and thus contra-indicatory. Such masks prove successful in limiting the transmission of the pandemic COVID19 (Shenoy and Brundha 2016). And thus it is recommended to the general population to use N95 respirators to defend themselves from respiratory diseases, especially coronavirus (COVID-19).

GENERAL USES OF N95 MASK

Many N95 respirators are generated for manufacturing and other forms of industrial employment that increase vulnerability to dust and tiny particles. They are supervised by the National Institute for Workplace Safety and Health (NIOSH) National Personal Protective Technology Laboratory (NPPTL), which is a component of the Centers for Disease Control and Prevention (CDC) (Gralton and McLaws 2011).
It is designed for industrial use, to help minimize wearer sensitivity to infective airborne biological aerosols, and to guard against the movement of pathogenic microorganisms, body fluids and other particulate matter (Ferdioz and Brundha 2016). They are built to minimize the wearer 's susceptibility to some airborne contaminants and oil-free aerosols but can not remove them (Figure 2). Employers and consumers are expected to comply, if necessary, to the OSHA Respiratory Safety Code, 29CFR 1910.134, and all federal or municipal legislation (Hu et al. 2012). In the current job market, these respirators (without valves) can also help protect the user from exhaling contaminants to others. They do provide unique guidelines for usage in commercial settings, alerts and limits. It is accredited by NIOSH (Fowler et al. 2004). These masks are intended mainly for the manufacturing, building and painting industries. Single use decontamination equipment is also authorised for the N95 masks. Protecting against nanostructured materials is deemed successful (Loeb et al. 2009). CDC uses ultraviolet germicidal radiation exposure and noxious hydrogen peroxide, and alternative approaches for the disinfection of N95 masks may require moist heat (Kuehn 2009).

ADVANTAGES OF N95 MASKS

N95 respirators have two benefits over plain fabric or surgical masks; they are > 95 percent effective in removing 0.3-μm molecules (less than the 5-μm size of broad droplets produced through speech, coughing, and sneezing that normally spread influenza) and are checked to insure contagious droplets and contaminants don't really leak across the mask (Swetha, Rani, and Brundha 2020). Even though N95 filtration for avian influenza is needless, N95 suit provides advantages over a loose-fitting surgical mask by preventing leakage across the mouth.
Such respirator models are streamlined and are maintenance-free. These are user friendly, comfortable and simple to use. Efficient reduction of temperature build-up by the valve that offers a cool effect thus making wear extra comfy. This has greater sustained wear duration and reduces the chance of spectacles and eyeglasses fogging as well (MacIntyre et al. 2013).
It can be used during this COVID19 pandemic as Personal Protective Equipment. These are meant for usage in a health care environment, primarily portable respiratory protection instruments that are utilized and used by healthcare workers to shield themselves against harmful microbes being transmitted. It has also been shown to be selective on certain SARS diseases (Chapple and Papapanou 2020).

COMPARING SURGICAL MASK AND N95 MASK

The most critical aspect about surgical masks to note is that they aren't built to satisfy a suit examination. When several surgical masks are used, there may be holes around the edges which will cause several tiny particles to reach the wearer's respiratory system (Nuorti et al. 2000).

A surgical mask is a loose-fitting, removable system providing a protective shield in the immediate area between the wearer's mouth and nose, and possible pollutants. It should also be noticed that the margins of the mask are not meant to create a seal across the mouth and nose. Such masks may not be exchanged, and can be classified as masks of anesthesia(Balaji, Brundha, and Path 2016), separation, dental or surgical treatment (Shreya and Brundha 2017).

An N95 respirator is a pulmonary safety system built to ensure a very near facial suit and quite effective atmospheric debris filtration. It should also be remembered that the respirator's margins are built to create a barrier across the mouth and nose.

Surgical masks are not authorized by NIOSH although N95 masks are devices licensed by NIOSH. N95 masks are fluid resistant to an approved standard calibrated against an artificial blood stream aimed at the respirator, whereas the surgical masks are not fluid resistant.

If correctly used, a surgical mask is designed to help absorb large-particle droplets, spatters, drips or splashes that can include microbes (viruses and bacteria)(Brundha 2015), stopping it from touching the nose and mouth. Surgical masks may also help to reduce certain people's access to the blood and respiratory secretions (Al-Wazzan et al. 2011).

Not expected to use medical masks more than once. When the mask becomes scratched or soiled, or if it is impossible to breathe through the mask, you can detach the face mask, properly uninstall it and substitute it with a fresh one. Place it in a plastic bag to securely remove the mask, then throw it in the garbage (Stone and Shiffman 2002). Clean your hands after removing the mask we were using.

In the meantime N95 masks are constructed and subject to rigorous inspection, at least 95 percent of very tiny (0.3 micron) research particles are absorbed by the respirator. If correctly designed, N95 respirators' filtration capacities go beyond those of face masks. But also a correctly designed N95 respirator will not reduce the possibility of disease or death entirely (Bradburn, Rips, and Shevell 1987).

LIMITATIONS

Issues remain because of differences in content, design, facial layout, cultural traditions and treating this mask may be less successful when created by inexperienced consumers. No simple, conclusive, and inexpensive check will prove effectiveness before any usage (Timothy, Samyuktha, and Brundha 2019). The mask can feel awkward to wearers. Individuals with documented or presumed respiratory issues such as emphysema, chronic obstructive pulmonary disease (COPD), asthma, and other cardiovascular / pulmonary problems may contact their doctor before using one (Kalaiselvi and Brundha 2016).

FUTURE SCOPE

This thesis is encouraging creativity to enhance the choices for respiratory safety. Prospective experiments will be performed to establish rates of safety achieved while inexperienced consumers create a particular mask from equivalent or related raw materials following directions (Hannah et al. 2019). Even more development in the advancement of personal protective equipment (PPE) should also be produced to further grasp the composition and applications of N95 masks would start to open fresh concepts in the medical field. Innovations are necessary as like educational systems (Brundha and Nallaswamy 2019)(Prashaanthi and Brundha 2018)in order to avoid the spread of terrifying respiratory disorder, COVID-19 and thereby contribute to increased health not just for patients, but also for medical staff

CONCLUSION

Effort is necessary to evaluate the minimum degree of security necessary while supplies are not accessible for N95 air-purifying respirators because the COVID19 pandemic hazard and other potential infectious strains may occur throughout the near future. This research thus makes a major contribution to learning about the

composition and uses of N 95 masks, and thus helps inform and simply make the public informed of the critical role of N 95 masks during this pandemic assault.

AUTHOR CONTRIBUTIONS

J. Dhivyadharshini, contributed to the data acquisition and drafting of manuscript. Dr. M. P. Brundha, contributed to design, editing and critical revision of the manuscript. Dr. Jayalakshmi, contributed to the supervision and proof reading of the manuscript.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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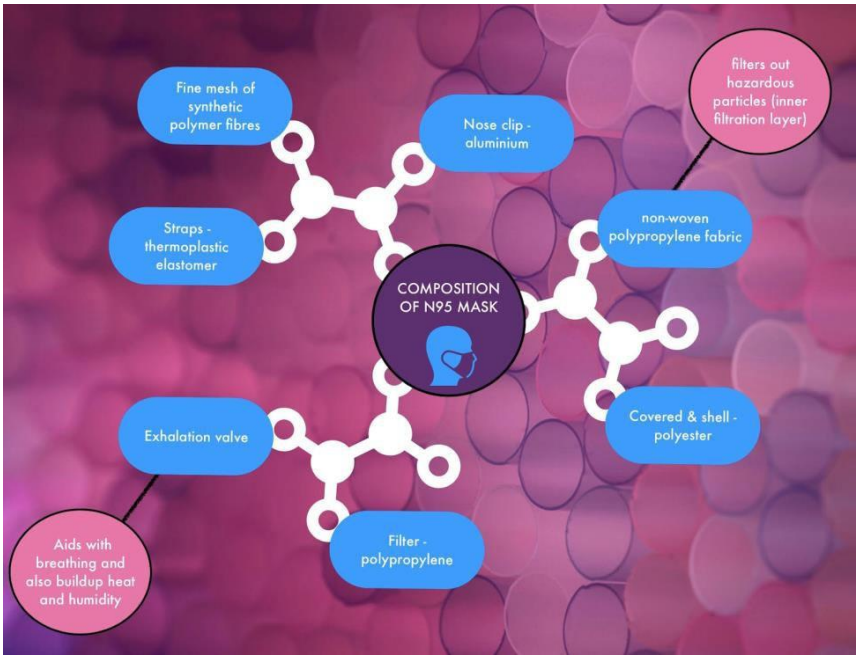

Figure 1: Self illustrated figure shows the composition of the N95 mask. A malleable band of aluminium over the nose has been provided in the N95 masks for a closer bond across the face and ears. N95 mask is composed of a quality mesh of artificial polymer matrix or non-woven polypropylene fibers created by the melt blowing process, which forms an internal purification membrane that separates out dangerous particles. This has an exhalation valve which facilitates breathing and also regulates heat and humidity buildup. The outermost layer or the shell of the N95 mask is made up of polyester which adds on the filtering capacity.

Figure 2: Self illustrated figure shows the uses of N95 masks. N95 masks are mainly designed for industrial use, it aids to minimize the wearer's sensitivity to infective airborne biological aerosols, and to guard against the movement of pathogenic microorganisms, body fluids and other particulate matter. They are built to minimize the wearer 's susceptibility to some airborne contaminants and oil-free aerosols but can not remove them. N95 masks are being widely used up during this COVID19 pandemic as Personal Protective Equipment (PPE) has it provides 95% protection against the airborne viruses.