ANTIVIRAL [redacted] MASK™

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DISCLOSURE

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EXECUTIVE SUMMARY

Introduction

Medical face mask is defined as a mask used for medical purposes especially to protect airway from any contamination.

Today, the used of face mask is crucial after the outbreak of air borne diseases such as influenza H1N1. For this reason, various types of face mask are introduced in Malaysia. Following the outbreak of H1N1, the shape and type of face mask is changed accordingly. Based on this, a new generation of face mask is introduced by [redacted] known as Antiviral [redacted]mask™.

This technology review was requested by Senior Principle Assistant Director of Medical Resource Unit following the proposal from [redacted]. to introduce the usage of Antiviral [redacted]mask™ in Ministry of Health facilities.

Objective /aim

The objective of this technology review was to assess the safety, efficacy or effectiveness and cost-effectiveness of Antiviral [redacted]mask™.

Results and conclusions

The search strategies did not yield any article regarding the safety, efficacy or effectiveness and cost-effectiveness of Antiviral [redacted]mask™. The only source of the studies was from the company itself. However, evidence on its efficacy and safety were laboratory studies. Clinical researches on human beings and in clinical setting are warranted.

Methods

Electronic databases were searched, which included PubMed, Ovid Medline (R) from 1990-2006 (EBM Reviews – Cochcrane Databases of Systematic Reviews), National Horizon Scanning, INAHTA and FDA website, for published reports. There was no limit in the search. Additional articles were identified from reviewing the bibliographies of retrieved articles.

The search strategy used the terms which were either used singly or in various combinations; "[redacted]mask", "[redacted]mask Medical Face Mask", "Study on [redacted]mask Medical Face Mask", "Medical Face Mask", "Antiviral Face Mask", "Intelligent Filtration Technology", "Sialic Acid", "FFP2" and, "cost-effectiveness of [redacted]mask".

ANTIVIRAL [redacted]MASK™

1. INTRODUCTION

Mask is an article normally worn on the face, typically for protection, concealment, performance, amusement, or to cover faces. It either covers the whole face or part of it.[1] Thus medical face mask is define as mask used for medical purposes especially to cover from any contamination and dangerous particulates.

Today, the used of face mask is crucial after the outbreak of air borne diseases such as influenza H1N1. For this reason, various types of face mask are introduced in Malaysia. Following the outbreak of H1N1, the shape and type of face mask is changed accordingly. Because of that, Ministry of Health takes an action to upgrade the physical interventions among health care personnel by introducing N95 face masks and hand washing campaign.

Jefferson T *et al*. did one systematic review in order to find the evidence of effectiveness of physical interventions to interrupt or reduce the spread of respiratory viruses. The review consists of 58 papers of 59 studies which included various types of study designs such as randomised trials, cohort, case-control, crossover, before and after, and time series studies. Out of these studies, all 4 randomised controlled trials were poor in quality; and the observational studies were of mixed quality. Meta-analysis of 6 case-control studies suggested that physical measures are highly effective in preventing the spread of severe acute respiratory syndrome; the findings were summarized in the table below:[2]

Table 1: Physical Interventions to Reduce the Spread of Respiratory Virus

Physical Interventions	Odds Ratio / Confidence Interval & Number Needed To Treat (NNT) / Confidence Interval	
Hand washing more than 10 times daily	Odds Ratio 95% Confidence interval	0.45 0.36 to 0.57
	NNT 95% confidence interval	4 3.65 to 5.52
Wearing Mask	Odds Ratio 95% Confidence interval	0.32 0.25 to 0.40
	NNT 95% confidence interval	6 4.54 to 15.41
Wearing N95 Masks	Odds Ratio 95% Confidence interval	0.09 0.03 to 0.30
	NNT 95% confidence interval	3 2.37 to 4.06
Wearing Gloves	Odds Ratio 95% Confidence interval	0.43 0.29 to 0.65
	NNT 95% confidence interval	5 4.15 to 15.41

Wearing Gowns	Odds Ratio	0.23
	95% Confidence interval	0.14 to 0.37
	NNT	5
	95% confidence interval	3.37 to 7.12
Hand washing, Masks, Gloves and Gowns Combined	Odds Ratio	0.09
	95% Confidence interval	0.02 to 0.35
	NNT	3
	95% confidence interval	2.66 to 4.97

The highest quality cluster randomised trials suggested that spread of respiratory viruses can be prevented by hygienic measures in younger children and within households. The systematic review concluded that, many simple and low cost interventions can reduce the transmission of epidemic respiratory viruses. However, more studies are needed to be conducted to find out which physical interventions were most flexible, effective and cost-effective.[2]

This technology review was requested by Senior Principle Assistant Director of Medical Resource Unit following the proposal from [redacted]. to introduce the usage of Antiviral [redacted]mask™ in Ministry of Health facilities.

Figure 1: The Antiviral [redacted]mask™

2. OBJECTIVE /AIM

The objective of this technology review was to assess the safety, efficacy or effectiveness and cost-effectiveness of Antiviral [redacted]mask™.

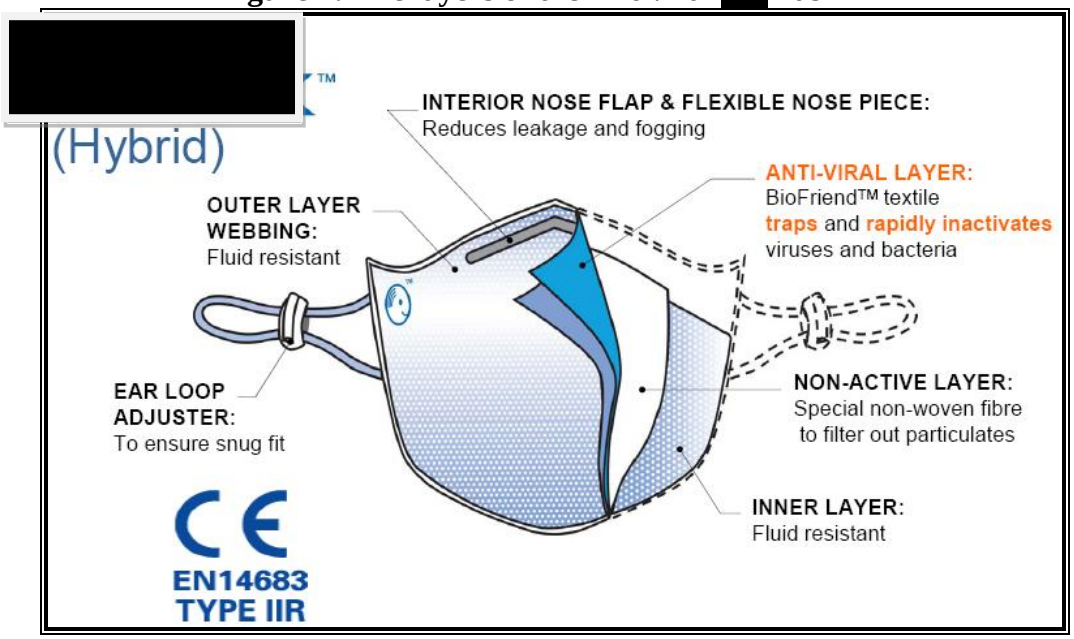
3. TECHNICAL FEATURES

A new generation of face mask has been recently introduce into the market with antiviral killer properties; Antiviral [redacted]mask™ from [redacted]. [redacted] is a company from Hong Kong, China. The company claimed that it has come out with a revolutionary technology called [redacted]friend™. The technology is belief to have the ability to kill viruses and bacteria on contact. The technology is applied to the substrates used in most of their products including the face mask; Antiviral [redacted]mask™.[3,4,5]

The [redacted] claimed that, Antiviral [redacted]mask™ is very new and has proven to give an optimum protection to the user. The Antiviral Biomask™ is using the [redacted]friend™ revolutionary technology which is claimed not only protecting the inhalation but also kill the viruses and bacteria on contact with the surface of the mask. The Antiviral [redacted]mask™ has several layers:-[3,4,5]

i)	Outer Layer Webbing	– Fluid Resistant
ii)	Antiviral Layer	– Active textiles in trapping and killing microbes.
iii)	Non-active Layer	– Special non-woven fibre to filter out particulates
iv)	Inner Layer	– Fluid Resistant

Figure 2: The layers of the Antiviral [redacted]mask™



3.1. Mechanism of Action

According to the [redacted], the technology will trap the microbes by mimicking the sites on human cells to which they normally attach, and then destroy them by disrupting their surfaces (viruses) and cell walls (bacteria). The company also claimed that the Antiviral [redacted]mask™ can kill germs which can cause Influenza A, Bird Flu, SARS, measles, pneumonia, common colds, tuberculosis, herpes, MRSA and gastroenteritis. The mechanism of action of [redacted]friend™ technology on the Antiviral [redacted]mask™ are as follows:[3,4,5]

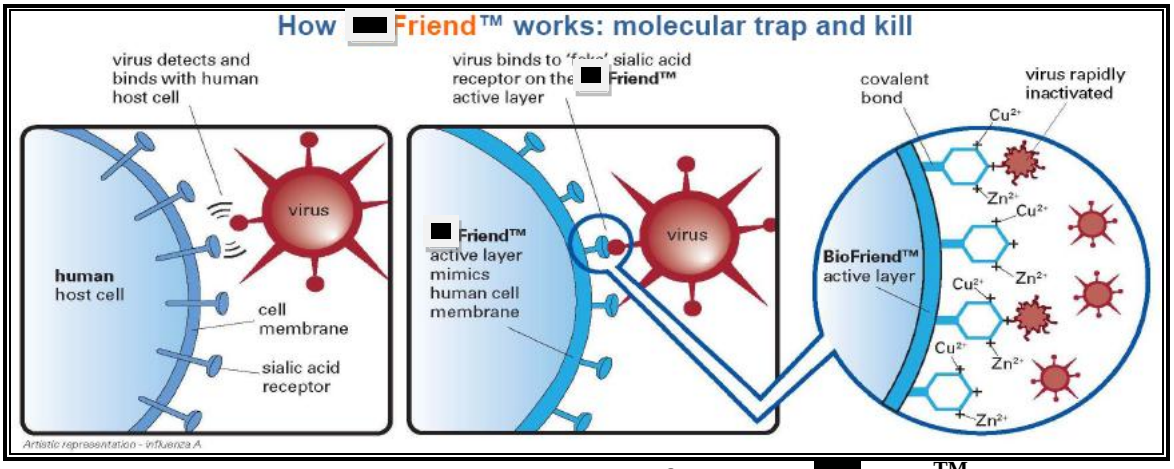


Figure 3: The Mechanism of Antiviral [redacted]mask™

i) Molecular Mimicry

Many viruses, including influenza viruses, are known to bind to human cells through oligosaccharides attached to cell membrane glycolipids or glycoprotein, specifically, to a terminal sialic acid residue on a surface oligosaccharide of the cell membrane. So the company stated that the binding agent in the [redacted]friend™ textile is mimicking the binding action of sialic acid on influenza viruses. The company claimed that the active layer which acted as binding agent is made up of component which already got FDA approval (not clearly stated by the company what the components are). This technique is often called 'molecular mimicry'. The company also claimed that the mechanism used in [redacted]mask™ is resistant to pathogen mutations, including pandemic strains.

ii) Molecular Trap

Once attached, the microbes are permanently locked on the binding agent. The [redacted] described the microbes as droplet-borne particulate; the infected droplets will quickly open by hydrophilic action and exposed the bacteria and viruses to the "trap and kill" properties of the active [redacted]friend™ material.

iii) Molecular Inactivation/Kill

Copper and zinc ions are ionically linked to the binding agent then rapidly inactivate the microbes. They affect micro-organisms by damaging biomolecules such as DNA, proteins and lipids, resulting in disruption to biological processes and the loss of membrane integrity, which inevitably leads to loss of cell viability. The cationic copper and zinc ions form electrostatics bonds with negatively charged sites on cell membranes, distorting permeability and creating ion imbalances that inhibit normal metabolism. Copper and zinc also bind to the sulfhydryl (thiol, -SH) groups of proteins, altering conformational structure, causing protein denaturation. Copper is also highly redox active and catalyses the production of reactive oxygen which damage the microbe's lipids, nucleic acids and proteins.

4. Methodology

4.1. Searching

Electronic databases were searched, included PubMed, Ovid Medline (R) from 1990-2006 EBM Reviews – Cochcrane Databases of Systematic Reviews, National Horizon Scanning, INAHTA and FDA, NIOSH website, for published reports. There was no limit in the search. Additional articles were identified from reviewing the bibliographies of retrieved articles.

The search strategy used the terms which were either used singly or in various combinations; "[redacted]mask", "[redacted]mask Medical Face Mask", "Study on [redacted]mask Medical Face Mask", "Medical Face Mask", "Antiviral Face Mask", "Intelligent Filtration Technology", "Sialic Acid", "FFP2" and, "cost-effectiveness of [redacted]mask".

4.2. Selection

All published articles related to the efficacy or effectiveness and safety of Antiviral [redacted]mask™ by [redacted] were included. Studies conducted in other field were excluded. Documents submitted by a company on Antiviral [redacted]mask™ were also included.

5. RESULTS AND DISCUSSION

The search strategies did not specifically yield any article regarding the safety, efficacy or effectiveness of Antiviral [redacted]mask™. The only source of the studies was from the company itself.

5.1. EFFICACY OR EFFECTIVENESS OF ANTIVIRAL BIOMASK™

No retrievable evidence from the scientific database regarding efficacy and effectiveness of Antiviral Biomask™. However the company claimed that the product just pass Filtering Face Piece 2 (FFP2) mask evaluation. FFP2 mask is a mask which has efficiency of filtering 95% particle and it is European Union (EU's) close equivalent to the American National Institute for Occupational Safety and Health (NIOSH) N95.[8]

Referring to [redacted]*friend™* [redacted]*mask (Anti-Infective) Full Independent Test Report, November 2009*, provided by the [redacted], 21 tests were done covering several types of microorganism including influenza virus H1N1 and bacteria. The test was done by [redacted] and [redacted] sponsored by [redacted] and [redacted]. Some of the studies conducted by those laboratories are briefly discussed in the subsection below.

5.1.1 Bacterial Filtration Efficiency and Differential Pressure

The objective of the study was to determine the Bacterial Filtration Efficiency (BFE) of various filtration materials, employing a ratio of the bacterial challenge counts to sample effluent counts, to determine BFE percentage. The techniques used to introduce the suspension of bacterial (Staphylococcus aureus) culture onto the samples were a basic physical principle of employing a water manometer differential upstream and downstream of the test material at a constant flow rate. The test samples, positive control sample and reference materials used were provided by the company. However the properties of the samples were not clearly described in the report. The bacterial culture suspension was pumped through a Chicago nebulizer at controlled flow rate and fixed air pressure. The process will formed aerosols droplets with a Mean Particle Size (MPS) of 3.0±0.3µm. The collection flow rate through the test sample and Andersen sampler was maintained at 28.3L/min (1 cubic foot per minute (CFM). Finally the Andersen sampler, a sieved sampler, impinged the aerosols droplets onto six agar plates based on the size of each droplet. The agar medium used was soybean casein digest agar. The agar plates were incubated at 32±2˚C for 48±4 hours and the colonies formed by each bacteria laden aerosol droplet were counted. From the report, the percentage of BFE for the Test sample was higher compared to positive controls and reference materials.[6]

5.1.2 (Evaluation of Viral Filtration Efficiency) Quantitative Determination of the Direct Contact Inactivation and Viral Filtration Efficiency of Treated Face Mask Materials against Aerosolized Human Influenza A Virus

The report was incomplete. Most data were under [redacted] authorization. It just stated that the study was performed according to the signed protocol sheets issued by the Study Director and was conducted from 2th July 2008 to 7th July 2008. The 3 test samples used were supplied by [redacted]; [redacted]mask™, non-active control and 3M particulate respirator. The challenge virus used was Human Influenza A Virus. The

numerical result was available in the [redacted]*friend*™ [redacted]*mask (Anti-Infective) Full Independent Test Report, November 2009*. However this was not clearly discussed.[6]

5.1.3 Assessment of Virucidal Effectiveness by Direct Contact Kill of Treated Face Mask Material - Using Human Influenza A Virus (H1N1): Misting Study

The report given was also incomplete. Most of the data were under [redacted] authorization. The study was performed according to the signed protocol sheets issued by the Study Director and was conducted from 8th October 2009 to 13th October 2009. Seven test samples (material from face mask tested) were supplied by [redacted]; [redacted]mask™ but this was not clearly described in the report. The virus used was Human Influenza A Virus (H1N1) from [redacted]. The result was available in the [redacted]*friend*™ [redacted]*mask (Anti-Infective) Full Independent Test Report, November 2009*. From the study it was claimed that there was a viral reduction for [redacted]friend™ technology compared to other test samples.[6]

5.1.4 Assessment of Antibacterial Activity of Treated Fabric Material – Using *Streptococcus pneumonia*: Misting Study

The report given was again incomplete. Most data are under [redacted] authorization. The study was performed according to the signed protocol sheets issued by the Study Director and was conducted from 8th July 2008 to 10th July 2008. Two test materials used were supplied by [redacted]; [redacted]friend™ textile and unmodified textile. The virus used is *Streptococcus pneumonia*. The result was available in the [redacted]*friend*™ [redacted]*mask (Anti-Infective) Full Independent Test Report, November 2009.* It showed a reduction of bacterial count on the [redacted]friend™ textile compared to unmodified textile.[6]

5.2. SAFETY

No retrievable evidence specifically on safety of Antiviral [redacted]mask™ can be found from scientific database except few studies given by the company. The studies were compiled in [redacted]*friend*™ [redacted]*mask (Anti-Infective) Full Independent Test Report, November 2009*. However, the Antiviral [redacted]mask™ got CE EN149:2001 certification on 13th February 2009. EN 149 is the European Respiratory Protection Standard for disposable filtering face piece respirators for particulates (usually dust, fumes, liquid mists) covering the nose, mouth and chin[7]. This technology does not have FDA approval. [3,4,5,6]

Referring to *Biofriend*™ [redacted]*mask (Anti-Infective) Full Independent Test Report, November 2009*, provided by the [redacted] Company, four tests were conducted to show the safety of Antiviral [redacted]mask™. The tests were done by [redacted] sponsored by [redacted]. The findings of these studies are described below:-

5.2.1 Primary Skin Irritation

The test was conducted by [redacted]. sponsored by [redacted] in accordance with the International Organization of Standardization: Biological Evaluation of Medical Devices, Part 10: Tests for Irritation and Sensitization. The samples involved were the test article and the negative control patches supplied by the sponsor. The samples were wet with tap water and applied to the shaved skin of 3 adult albino rabbits. They were left for 4 hours. Observations of any skin irritation were conducted at 60±6 minutes after unwrapping and 24, 48 and 72±2 hours. The scores were totalled and averaged for the test article and negative control. The observations were looking for any occurrence of erythema, edema and necrosis. At the end of the study, it showed no significant dermal reactions observed at the test sites on the rabbits after 60 minutes, 24 hours, 48hours and 72 hours.[6]

5.2.2 Toxicity Risk Assessment of Antiviral [redacted]mask™

This study was also conducted by [redacted] and sponsored by [redacted] The objective of the assessment was to identify the potential for toxicity of the extractable substances from the FM200-3011 [redacted]mask™ surgical facemask in comparison to the control mask under dynamic flow conditions. The numbers of metal substances investigated were 32 types. However, the traced substances pass through both types of samples were sodium, boron and aluminium. Some organic compounds such as acetic acid and hydrocarbon substances were also traced. According to the report the amount of the compound passed was very low for both samples but the Antiviral [redacted]mask™ showed the lowest amount compared to the control mask. The company claimed that the amount of those substances were very small and far from a toxic level.[6]

5.3. COST- EFFECTIVENESS

There was no retrievable evidence on the cost-effectiveness of Antiviral [redacted]mask™. However, the price is £3.00 or US$5.00 per mask.[9] According to [redacted] (the main medical supplier in Malaysia) the price for Malaysian market is about RM6.00 per mask.

6. CONCLUSION

6.1. EFFICACY OR EFFECTIVENESS

No retrievable evidence on the efficacy and effectiveness of Antiviral [redacted]mask™ could be found from the scientific database. However, evidence on its efficacy was laboratory studies. Clinical researches on human beings and in clinical setting are warranted.

6.2. SAFETY

No retrievable evidence on the safety of Antiviral [redacted]mask™ could be found from the scientific database. However, the evidence from the company showed no significant dermal irritation with low toxicity risk in animal (adult albino rabbit).

6.3. COST- EFFECTIVENESS

There was no retrievable evidence on cost-effectiveness of Antiviral [redacted]mask™.

7. REFERENCES

1. Mask Definition. Available at http://en.wikipedia.org/wiki/Mask

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8. APPENDIX

8.1 Appendix 1

DESIGNATION OF LEVELS OF EVIDENCE

I Evidence obtained from at least one properly designed randomized controlled trial.

II-I Evidence obtained from well-designed controlled trials without randomization.

II-2 Evidence obtained from well-designed cohort or case-control analytic studies, preferably from more than one centre or research group.

II-3 Evidence obtained from multiple time series with or without the intervention. Dramatic results in uncontrolled experiments (such as the results of the introduction of penicillin treatment in the 1940s) could also be regarded as this type of evidence.

III Opinions or respected authorities, based on clinical experience; descriptive studies and case reports; or reports of expert committees.

SOURCE: US/CANADIAN PREVENTIVE SERVICES TASK FORCE (Harris 2001)

UPDATE **Addendum** **24th AUGUST 2011**

Malaysia Health Technology Assessment (MaHTAS) Unit received new information on the Antiviral Biomask from the manufacturer / distributor. Herewith is the updated information about this medical device.

SAFETY

Through the search in the United State Food and Drug Administration (USFDA) website, it was found that, on 26 Mei 2011, USFDA gave 510(K) clearance to the Biofriend Biomask Surgical Facemask, Models Universal BF-200-2001 and Premium BF-200-3013 Filligent Limited with 510(K) number K101128.

EFFICACY/EFFECTIVENESS

No new evidence was found from the evidence search in the available scientific databases in MaHTAS.

CONCLUSION

There was no new clinical evidence on the efficacy/effectiveness, and cost-effectiveness of Antiviral Biomask™. However, it has received the 510(k) clearance from the USFDA.

RECOMMENDATION

The effectiveness of Antiviral Biomask™ is still inconclusive when used to kill viruses including H1N1 virus while filtering the viruses. However, it can be recommended for use in Ministry of Health facilities as a research tools in research environment to provide more quality evidence. However, the price per piece of the Antiviral Biomask is about RM4 to RM6 as compared to the price of currently used N95 masks is about RM5 (RM100 for 20 pieces of N95 mask)

REFERENCES

1. USFDA website.