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PERSPECTIVE

A Novel Concept to Prevent and Treat Respiratory Infections

Chaouki Neifer
Cardiovascular surgery department, Mercy hospital, Metz, France.

ABSTRACT
Actual systems of prevention and treatment of new emerging airborne germs seem to be ineffective as shown with the ongoing Covid-19 pandemic. Here I present a novel concept allowing to develop specific immunity when being exposed without even getting infected. I concretize this concept in a facial device whose composition, way of use, and potential interests are detailed in this paper.

KEYWORDS : Covid-19; novel device; respiratory infections; prophylactic treatment; UV-C sterilization.

Correspondence: Dr Chaouki Neifer. Hôpital Mercy, Service de chirurgie cardiaque, 01 Allée du château – CS 45001, 57085 Metz, Cedex 03, France. Email : chawkineifar@yahoo.fr

INTRODUCTION

Respiratory infections, often benign, constitute a public health concern for at least two reasons. Firstly, the airborne germs ability to spread rapidly by air and touch causing explosive worldwide epidemics. Secondly, the unpredictable mutations capacity leading to more virulent germs, particularly aggressive in frail people. A mutant coronavirus [1] is already infecting more than thirty million people and killing more than nine hundred thousand persons trough the world [2].

Actual universal systems to prevent epidemic respiratory infections lean on two kinds of measures :

- Limit mutation risk by inciting people to avoid contact with wild animal reservoirs. This measure is not well applied everywhere, especially in some Asian countries like China [3].
- Limit infections spread by imposing various social rules and restrictions. Efficacy of this measure is proportional to the firmness and duration of social restrictions which are proportional, in the other hand, to the economic loss [4] and psychologic disturbances [5].

Treatment of respiratory viral infections involves a fight against symptoms (antipyretics, oxygen ..) and complications (antibiotics, artificial ventilation..). There are no specific drugs when a new mutant virus emerges. Manufacturing of vaccines, synthetic antibodies, and/or antiviral dedicated drugs requires a lot of time (months/years) and money [6]. Besides toxicity risks and other therapeutic hazards of any novel drug, these specific treatments seem to be problematic for three reasons :

- (delayed) Availability : laboratory development of vaccines and antibodies takes several months or years to be achieved. Meanwhile, virus is already spread everywhere causing thousands of deaths.
- (uncertain) Efficiency: during period (months/years) to develop these specific treatments, virus would meanwhile be mutated [7]. Novel drugs, when manufactured, would no longer be effective.
- (high) Costs.

So, when a new mutant respiratory germ infects one person, all people on earth may be rapidly concerned. Preventive measures are then socially agonizing and economically paralyzing. Specific treatment is delayed and uncertainly efficient when available. In short, with current medical expertise, a new mutant respiratory germ leads inevitably to a universal disaster as we can see with the ongoing pandemic Covid-19.

HYPOTHESIS

"enjoy airborne microbes exposure to be immunised without getting infected"

Formulation 1 :

We have a facial device that inactivates in real time airborne microbes at the entrance of the mouth and nostrils. Inactivated antigens will be recognized by immune cells which will synthetize specific antibodies. Exposed person is already immune before even getting infected.

This device, ideally, should meet three imperatives :

1. Sufficiently biocide to inactivate all microbes.
2. Totally harmless to not damage host cells.
3. Always reusable to guarantee daily population use.

Reviewing properties of current usual chemical and physical germicide agents, there is no one matching instantaneous airborne germs inactivation when breathing (imperative n°1) and sparing human cells damaging (imperative n°2). Chemical products cause lungs and airways injuries if inhaled. Physical agents like UV radiations may directly be responsible of burns and cancers, and can indirectly cause airways injuries by transforming oxygen in ozone. Temping find a revolutionary product that resolve this dilemma, we can reformulate our hypothesis to reach the same objective with current available biocides.

Formulation 2 :

We have a facial device that inhibits airborne microbes airways penetration, inactivates them after exposure, and then represents them at the entrance of the mouth and nostrils. Inactivated antigens will be recognized by immune cells which will synthetize specific antibodies. Exposed person is already immune before even getting infected.

In order to respond to this hypothesis, a simple solution seems to be relevant : we use a microbes filter during exposure, then we sterilize it, then we reverse its sides and reuse it.

To do this properly, with a standardized approach, avoiding the risk to be contaminated when manipulating used filters, I propose a facial device composed as follow:

- Inert frame including :
  - An impervious mask, ideally made by transparent material to allow facial recognition.
  - Temples fixed overs the ears like eyeglasses.
  - (additional) Eyeglasses for eyes protection and, if needed, vision correction.
- Removable filter with high filtration capacity of double sides.
- Box storage incorporating an UV-C LED system for device sterilization.

How does that work? (Figures 1, 2, and 3)

Device is worn like eyeglasses before going out or meeting people (before being exposed). After exposure, device is stored into the box sterilizer by handling only the temples. Once sterilized, filter is reversed. Device is then ready for reuse.

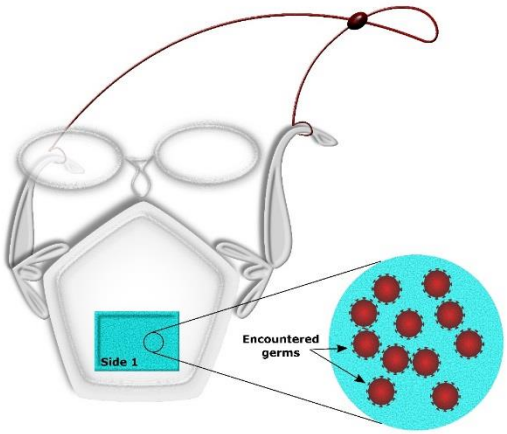

Figure 1 : Exposed device

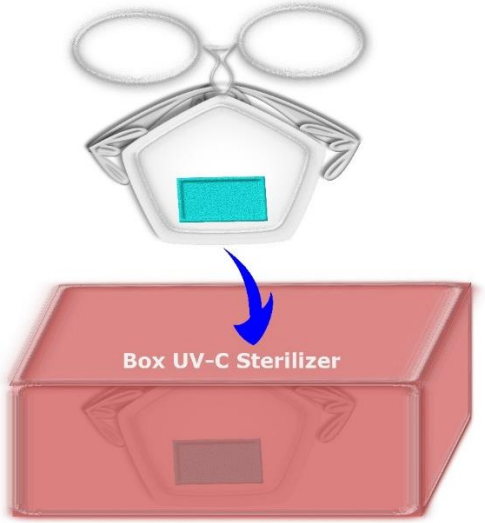

Figure 2 : Device sterilization with portative UV-C box.

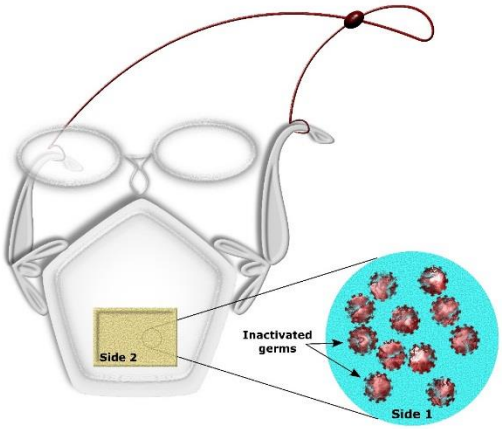

Figure 3 : Sterilized device reusing the same filter after reversing sides.

DISCUSSION

Feasibility :

Thanks to efforts of professors Akasaki and Amano, recipients of physics Nobel prize in 2014 [8], artificial UV-C radiation production no longer requires mercury vapor sources which necessitate heavy installation, high electric energy, and polluting materials [9]. UV-C radiation can actually be produced using LED components with small surface area (1 mm^2), low voltage (5 V), instantaneous on/off, and high lifetime expectancy (over 10.000 hours) [10]. These advances opened the door for a wide range of applications in compact devices, such as mobile device case sanitizers [11]. A portative box UV-C sterilizer as described above is clearly feasible.

Efficiency :

UV-C radiation induces nucleotide photolesions [12] damaging genomic material of exposed species. Germicide UV capacity was first being tested by 1930s with a renewed interest for sterilization use by 1990s [13]. Inactivating action is effective against a wide range of microorganisms including bacteria, viruses and fungi [14]. Use of LEDs UV-C procures the same efficiency comparatively to conventional mercury vapor sources [15].

Use of killed or inactivated germs is well known to confer the most effective vaccination-induced immunity [16]. This immunity depends on type of germ, exposure frequency, and host immune system quality. With this device conception, immune system is continuously stimulated without delay by inactivated comminatory germs allowing specific antibodies synthesis. This would confer a real protection against ongoing respiratory infections, in contrast to conventional vaccines created in response to anterior germs strains which may no longer exist.

Safety :

To be 100 % safe, device sterilization must ensure complete inactivation of all encountered germs. Airborne germs sensibility to UV-C radiation depends on UV wave length, germ nature, and dose of UV-C radiation [14]. Experiments are required to determine the best parameters to apply to this device in order to inactivate all airborne germs.

Potential interests :

Prevention and prophylactic treatment of all comminatory respiratory infections. This device conception would not only be efficient against the ongoing covid-19 pandemic, but also might combat all other airborne germs, viral and bacterial ones, killing every year more than four million persons through the world [17].

Maximum protection against airborne germs. Conventionnel masks and eyeglasses may be a vector for infection transmission when not used correctly. Also, some infections may be transmitted by ocular inoculation [18]. Conception of this device incorporating easy manipulating temples and protective eyeglasses with systematic sterilization after each exposure would ensure the best protection against encountered germs.

Economic solution. Even if the purchase price might be higher than a conventional mask, using reusable filters would ultimately make it more economic.

Environment protection. Contaminated used masks constitute a polluting waste which may participate in germs spread everywhere. Using our device, even reused filters would be sterilized before throw, making this system environmentally friendly.

Practical use. Conventional facial protection against airborne germs necessitates manipulation of two or three objects (masks, eyeglasses, visors) generating discomfort and contamination errors. Our system allows a whole facial protection using only one device with systematic easy sterilization after each exposure. Box sterilizer functioning with a low voltage might be easily powered even with USB (universal serial bus) connection.

CONCLUSION

Because everything is in continuous changes around us, our way of thinking should change in parallel to overcome new challenges. Instead of trying to solely push back enemies (airborne germs), we could enjoy their attempted invasion to produce without delay effective arms (specific antibodies) while keeping properly protected.

ACKNOWLEDGMENTS

Considering the emergency to find solutions for the ongoing Covid-19 pandemic, I did not search to protect this invention by a patent. Saving lives is already a win. Nevertheless, it would be humble to recognize invention rights when using this conception for commercial purposes.

CONFLICT OF INTERESTS

I declare that I have no conflicts of interest related to this work.

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