Homemade ventilator decontamination approach

Bacteria is everywhere. This is the first thing any health professional is taught when they attend their first microbiology lecture. Bacteria can be found on every surface, on our skin, up your nose, in your hair and over half of the cells of your body are actually bacterial cells. The average human harbours millions of harmless bacteria in their mouth, mucous membranes, intestines etc these are what we call symbiotic bacteria. Symbiotic bacteria live in harmony with us within our bodies and may even aid in some biological functions such as digestion. Other microbes may also live symbiotically for example viruses. Most people are currently infected with viruses such as Epstein Barr virus (EBV) or the human papilloma virus(HPV) and yet never develop symptoms. The issue arises when humans come into contact with a particularly virulent novel bacteria or virus that our bodies are not equipped to deal with and so illness may develop.

Nosocomial infections or hospital acquired infections are ever increasing today. Some of the major players in this arena are methicillin resistant staphylococcus aureus (MRSA), vancomycin resistant enterococci (VRE) and other drug resistant bacteria (Anderson, et al., 2012). It is absolutely paramount to the wellbeing of patients that treatment is carried out in the most sterile, aseptic manner possible in order to reduce nosocomial infections from and as such any interventional medical device must be decontaminated according to strict sterilisation procedures.

Building on from the suggestions of Md Saffiullah Sarker, it is not adequate to simply place a medical device into a gas sealed jar with liquid hydrogen peroxide floating in the bottom and hope that it will be decontaminated. Not only does the liquid need to be vaporised to form a dry mist using some form of vaporising device but there must be a step by step pre and post sterilisation procedure implemented. For this, highly trained staff are needed as well as a decontamination room.

Most medical devices will have a disposable part and a reusable part. The disposable part is usually the part that will come in direct contact with the patient. Prior to the reusable device arriving at the patients' bedside it will have been decontaminated externally and on the difficult to reach internal parts. This is done manually and chemically. For the purpose of this concept the following rough procedure is suggested:

1. Trained personnel will take the device to a decontamination room. If there is no decontamination room available, the device must be in as sterile a place possible.
2. Personnel must wear personal protective equipment. They must have exceptional aseptic technique. Training is paramount at this point.
3. The external surfaces of the device can be cleaned manually using an industrial strength disinfectant such as klorsept or 70% alcohol.
4. Every single area of the device from top to bottom must be cleaned.
5. The harder to reach/electronic parts of the device will have to be cleaned chemically using dry mist hydrogen peroxide.
6. At this point the device including the pump can be placed into the gas sealed jar mechanism suggested by Md Sarker.
7. The hydrogen peroxide cannot be simply poured into the jar in liquid form. *see notes
8. Once the hydrogen peroxide is vaporised, the device should be left to sit for 30 minutes. (Ideally as per Anderson et al the device should sit for two hours and the procedure cycled three times).
9. Extraction of the device from the sealed jar should be carried out in a separate area from the pre-decontamination area. An area that can be termed the “clean” area.
10. Personnel should wear new sterile PPE when extracting the device.
11. To test the effectiveness of the procedure swabs using sterile saline solution should be taken at this point from the external surfaces and if possible the internal surfaces for processing in a microbiology lab.
12. Microbiology can process the swabs on blood agar, MacConkey and Mannitol salt agar for some of the most common microbes found in hospital settings (Darge, et al., 2019)
13. The device must then be promptly placed into a sterile plastic bag and sealed.

*notes

The current design of the gas sealed jar lacks a vaporising mechanism. As this project is based on the premise of using everyday household items to make a ventilator it is only logical that the sterilisation mechanism derive from the same origin. Vaporisers or “vapes” are everywhere these days. Within a the small smoking mechanisms is a vaporising mechanism that converts liquid to gas at very low temperatures which is ideal for the conversion of hydrogen peroxide to a gaseous state. Theoretically, in a dire situation a modern day vape that can be obtained in any corner store can be used to convert liquid hydrogen peroxide to

dry mist hydrogen peroxide. As I am a medical scientist and my knowledge only extends as far as the biological aspects of this project, I cannot advise on how the vape will be integrated into the design but I can only highlight a role it can play as a potential sterilisation agent.

Kirsty Mc Loughlin, contracted via Upworks. April 2020.

Works Cited

Anderson, B., Hochlin, K. & Daling, J., 2012. Cleaning and decontamination of reusable medical equipments, including the use of hydrogen peroxide gas decontamination.. *Journal of microbial & biochemical technology,* 4(2), pp. 057-062.

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