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Respiratory protection issues in relation to SARS (Severe Acute Respiratory Syndrome

Introduction

- This note is a viewpoint as to the current information available with regard to respiratory protection with SARS, in particular to workplace settings. Only practical respiratory protection is covered, whereas other means of preventing transmission of viruses or liquids are also important.
- The virus has been identified as a new pathogen, never before seen in humans[1]. Safe exposure standards have not been established for bacteria and viruses[2] and gives rise to difficulty in deciding what level of protection is required. Generally, high efficiency particulate filters are required and these should be the type approved for liquid aerosols[3].
- There appears to be considerable confusion by advisory bodies, particularly in the health care environment[4], as to the most appropriate means to protect workers from potential contact. There are increasing numbers of people questioning the advice given in New Zealand and internationally[5] [6] [7].
- The protection of HCWs is a particularly important issue because of the likelihood of transfer of risk.

[1] WHO 2003. http://www.who.int/mediacentre/releases/2003/pr31/2n/

[2] Because of the ability of micro-organisms to multiply inside the human body, the number of inhaled particles likley to result in infection is the critical issue. This is in contrast with the traditional chemical aerosols of poisonous substances in which the inhaled mass is usually quoted.

[3] European Standards 2003. European Respiratory Standards explained. Special considerations in the selection of respirators. Bacteria and virus.

[4] Much of the source of information is probably derived from documents such as the CDC "TB Respiratory Protection Program in Health Care Facilities", available from the website http://cdc.gov/niosh/99-143.html Unfortunately, many of the practical recommendations for use given in the document are not possible.

[5] Listrserve for Emergency Medical Practioners: On Breath. http://www.ucsf.edu/its/listserv/emed-1/11346.html

[6] March and April 03. The author has written to both the CDC (USA) and the NZ Ministry of Health, expressing concern as to incorrect advice being given to HCWs (Health Care Workers).

[7] Bromwich D. 2003. Queensland University, Australia.

Particle size and characteristics

In order to provide any advice related to respiratory protection against biological agents, a knowledge of the particle size and structure is necessary. Deposition, solubility and a number of other factors are important criteria in the selection of respiratory protection, as is proximity to the contamination source, level of ventilation or dilution and the manner of transfer of risk. At the present time SARS particle characteristics are not clear.

In general:

- Viruses are small particles, generally in the order of 0.2-0.6 micron size[8].
- It is possible that the biological contaminant is absorbed in both smaller and larger aqueous liquid expelled from the mouth. These will be both at micron size and larger[9].

"Fit" of a respirator

This is a critical consideration in any respiratory protection, including those in health care settings[10]. It is very difficult to obtain a good facial fit with a disposable respirator, hence allowing leakage of contaminant to the wearer. In addition, any facial obstruction such as beards or large moustaches or facial shapes that are larger or smaller than standard, have altered as a result of dental changes, injuries or other factors such as diet will significantly alter the fit.

A face fit test method equipment such as a Portacount particle tester is essential.

Unfortunately, personal checks on face fit are not reliable and are usually impossible to achieve with disposable type of respiratory equipment.

Training and education

This is critically important to any person required to wear respiratory protection as an understanding of the limitations of the equipment and correct maintenance, disposal and a number of other factors such as hygiene and impact of facial hair is necessary.

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[8] Rajans G S and Blackwell D S L.1985. Practical guide to respirator usage in industry. Pp 12. Boston: Butterworths.

[9] For comparison, aqueous particles considered in TB settings are typically 1-5 micron size (see the CDC document below).

[10] This has been researched in many health care settings, for example, Nicas M. 1995. Respiratory protection and the risk of Mycobacterium tuberculosis infection. American Journal of Industrial Medicine. March. Vol. 27, No. 3, Pp 317-333. (38 references)

Surgical masks

These devices should never be used to protect people from airborne particles[11]. Surgical masks are not designed to protect the wearer from exhaling airborne hazards (not inhaling). The devices are also not approved for this use. The primary purpose of a surgical masks is to prevent very large particles from being expelled to the environment by the wearer[12]. The equipment has no place in any respiratory protection programme.

N95 respirators

The designation is an American classification and indicates that under the test methods in the laboratory, 95% of particles are captured with a GMD (Geometric Mean Diameter) of 1.6 micron (or 5% will pass through). This is in addition to the large leakage that will result in the practical environment where face fit is not possible and where no training in respiratory protection has been carried out.

Other respirators of the disposable type are allowed to transmit greater than 20% particles through the respirator, but in practice much greater leakage of particles will result due to face fit factors.

Current USA and Australasian Standards require filter testing at low air flow rates, e.g., 30 and 95 lpm (litres per minute). Work done by the author (submitted for publication in the ISRP[13]) typically show rates in excess of 400 lpm. Since particle retention is partly dependent on flow rates, the retention of particles in the practical work environment will be much less than allowed under Standards. This has important implications.

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[11] There are a number of publications, even as far back as 1993 the American Journal of Infection Control concluded with, "The protection offered by surgical masks may be insufficient in environments containing potentially hazardous sub-micrometer aerosols". Later publications have repeated this warning. (Available from the author).

[12] This has been well known for some time, but a misleading paradigm exists in the medical community. For examples of publications related to this issue, see for exmple, Gilmore F I. Respiratory protection against tuberculosis: the tip of the iceberg. Professional Safety, Vol 39, No. 10. Pp 37-39. (5 References). "Surgical masks which were intended only to protect surgical patients from droplets emitted by hospital personnel are ineffective against TB, organic vapours and dusts".

[13] Wallaart, J. 2003. The determination of peak inspiratory air flows (PIAF) at various levels of work and the increased air flows that result when communicating in the work place. Submitted to the International Society of Respiratory Protection for publication.

Recommendations

- Respiratory protection is the last method of defence. All other possible avenues for protection need to be exhausted first,
- If respiratory protection is to be introduced, maintenance programmes, education and training, medical screening, safe working practices and methods of disposal and a host of other factors need to be introduced[14].
- Surgical and similar masks provide limited or no protection. This is important. Workers who believe they are protected with these devices (e.g., HCWs such as nursing staff) may expose themselves to risk that they would otherwise not expose themselves to,
- N95 and similar cheap respirators provide limited and unacceptable protection,
- HEPA[15] and better filters[16] are required for respiratory protection.
- Close face fit of any respirator is important. Only with FPBR[17] or air-line respiratory protection facial fit is not so critical.
- Respiratory protection programmes require the complete commitment of an employer[18],
- Particularly for HCWs, protection such as that available from P4 filters, good facial fit equipment and modern respiratory protective equipment such as an FPBR are essential.

[14] AS/NZS 1715:1994. Selection, use and maintenance of respiratory protective devices.
[15] High Efficiency Particulate Air filters.
[16] There are P4 filters available at 99.997% retention.
[17] Fan supplied, Positive Presssure, Breath responsive Respirator. This modern equipment has been developed and is marketed by Safety Equipment Australia Pt Ltd, Sydney and also internationally in the USA and Europe.
[18] There aremany publications confirming this in health care settings. For example, Schaefer J A. Respiratory protection in the health care setting. Occupational medicine: State of the Art Reviews, Vol. 12., No. 4, Pp 641-654 (11 references).