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Microbial contamination of non-invasive ventilation devices used by adults with cystic fibrosis☆

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SUMMARY

Background: There is currently little evidence regarding potential risks of bacterial contamination of non-invasive ventilation (NIV) devices used by cystic fibrosis (CF) patients.

Aim: The aim of this study was to determine the extent of bacterial contamination of NIV devices in our regional adult CF centre.

Methods: Seven NIV devices recently used by CF patients chronically infected with *Pseudomonas aeruginosa* or *Burkholderia cepacia* complex (BCC) were swabbed in seven areas, both external and internal. Two devices had undergone ethylene oxide (EtO) sterilization between patient use and swabbing, and five devices had not undergone EtO sterilization.

Findings: Swabs from five devices had insignificant growth of environmental organisms and two devices had significant growth of environmental organisms. No CF pathogens were isolated from any machine.

Conclusions: No evidence was found of pathogenic microbial contamination of NIV devices used by CF patients in this small study. We suggest that further studies examine for evidence of bacterial contamination of NIV devices and that this issue should be included in future CF infection control guidelines.

Introduction

Non-invasive ventilation (NIV) devices are commonly used by cystic fibrosis (CF) patients with hypercapnic respiratory failure or as an adjunct to improve sputum clearance.[1] Since NIV devices may be used by more than one patient, there is potential for bacterial cross-infection. However, despite their widespread use in CF, there is currently little evidence with regard to potential risks of bacterial contamination of NIV devices. Indeed, unlike spirometers and nebulizer equipment, NIV devices are not discussed in international CF infection control guidelines.[2,3]

Prior to this study, the practice at West Midlands Adult Cystic Fibrosis Centre had been to clean and disinfect the external surfaces of NIV devices between patients and to use single-patient use outlet bacterial/viral filters where possible (when use was not precluded by the use of an integral NIV humidifier). In addition, the practice was to send NIV devices for ethylene oxide (EtO) sterilization if the last patient to use

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Table I
Details of non-invasive ventilation devices and last patient to use each device prior to swabbing

Device no.	Device details	Sputum microbiology	EtO status
1	VPAP™ III	*P. aeruginosa*	Pre-EtO sterilization
2	VPAP™ III ST	*P. aeruginosa*	Pre-EtO sterilization
3	VPAP™ III ST	*P. aeruginosa*	Pre-EtO sterilization
4	VPAP™ III ST	*P. aeruginosa* and candida	Pre-EtO sterilization
5	BiPAP® Harmony™ S/T	*B. cepacia* complex	Pre-EtO sterilization
6	VPAP™ IV ST	*B. cepacia* complex	Post-EtO sterilization
7	VPAP™ III ST	*B. cepacia* complex	Post-EtO sterilization

a device had a significant airway infection besides *Pseudomonas aeruginosa* [e.g. *Burkholderia cepacia* complex (BCC) organisms] or if the use of an outlet bacterial/viral filter was not feasible (if an integral humidifier was used).[4]

Despite these measures, there was concern that CF pathogens could be drawn into the device through the air inlet port and accumulate on the internal surfaces of the device. This raised the theoretical concern that any pathogens within the devices could be transmitted to another patient via the tubing and interface. It was therefore decided to conduct a prospective quality improvement study to examine the extent and nature of microbial contamination of NIV devices in this regional adult CF centre.

Methods

Seven NIV devices were selected from the pool of 21 devices routinely used by CF patients at the Centre. Devices 1–4 had never been used by BCC-infected patients, whereas the last patients to use devices 5–7 were chronically infected by BCC. Two of the devices had undergone EtO sterilization, and five devices had not undergone EtO sterilization, following use by the previous patient. Following EtO sterilization, devices were stored in clean plastic boxes until swabbing was performed. The time interval between EtO sterilization and swabbing varied between 7 and 16 weeks. Table I describes the NIV devices examined in this study, the organisms infecting the patient last using each device as well as the 'EtO status'.

A specialist NIV medical engineer carefully dismantled the devices inside an autoclave bag in a clean side-room. The engineer wore clean gloves and aprons and took precautions to avoid environmental contamination. Each device was swabbed in seven areas: outer surface of the machine, air inlet filter, air inlet filter housing (after removing the filter), air inlet outer area, air inlet inner area, 'blower surface' of the turbine and the area where the turbine sits.

Swabbing was performed with sterile swabs moistened with sterile water (Figures 1 and 2). Following swabbing, samples were inserted into Amie's transport medium, labelled appropriately and brought back to the laboratory.

On arrival at the Centre's research and development laboratory, each swab was immediately streaked out on to three sets of culture plates: blood agar (BA), cysteine lactose electrolyte-deficient (CLED) agar and Sabouraud agar (all manufactured by Oxoid Ltd, Basingstoke, UK). The air inlet filter was removed into a sterile universal container and later soaked in broth and cultured on agar. Plates were incubated for between two and five days at 37 °C. *B. cepacia*-specific culture medium (Oxoid Ltd) was also used for the air inlet filter and air inlet filter housing swab from device 5 and the internal surface swabs and air inlet filter housing swab of device 6. *B. cepacia*-specific culture medium was incubated at 37 °C for the first two days and then incubated at 30 °C for five days. All plates were read at 24 and 48 h, then discarded after five days of incubation. Micro-organisms were differentiated by morphological and Gram stain characteristics, and basic biochemical tests (e.g. oxidase and catalase tests) were performed. Staph latex

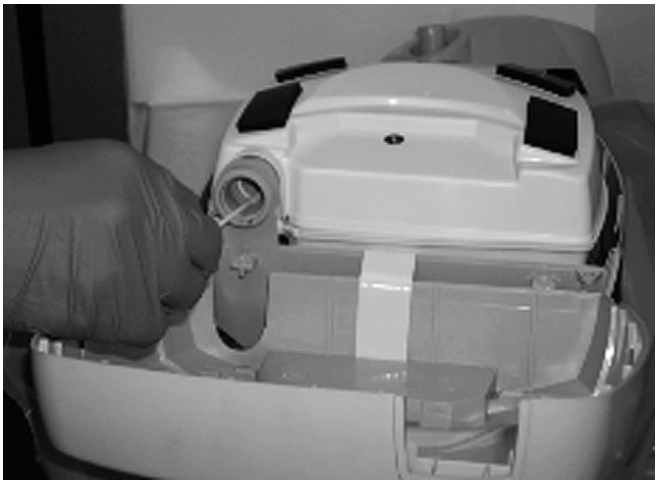

Figure 1. Swabbing the non-invasive ventilation device air outlet: outer area.

Figure 2. Swabbing the non-invasive ventilation device air inlet filter housing.