



# CPAP Masks are Sources of Microbial Contamination

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## RATIONALE AND AIMS

- CPAP compliance is a priority in managing apnea patients. An area that has had little investigation is a patient's ability to care for their CPAP at home and the effect this may have on utilization. Patients may have more nasal congestion and sneezing limiting CPAP use.
- Respiratory therapists advise patients to wash the interface weekly.
- Just as simple hand washing is recommended as the best way to prevent spread of bacteria and viruses such as NIT1, cleaning CPAP equipment should decrease spread of upper respiratory and oral pathogens. Patients carry their masks largely unprotected for months, taking them outside the home into hospitals, on planes and other environments conducive to growth of pathogens.
- Studies of nasal cytology have noted patients with higher nasal neutrophil count were more likely to abandon CPAP.

## METHODS

- 24 of 30 consecutive patients had CPAP interfaces >1 month old submitted for culture.
- Patients were 16 men and 8 women age range 24-64 years old.
  - 42% of patients had AHI >40 and all had AHI >20
- Objective and subjective compliance data were recorded and CGI scores were measured as well as frequency of mask/humidifier cleaning and age of interface.
- Swabs were taken from the inner surface of the mask and the base of hose and humidifier.
- Bacterial cultures were examined and gram stained at 24 and 48 hours, fungal cultures at 72 hours.
- We correlated frequency of cleaning and severity of apnea as well as interface styles and mask age with bacterial colony counts.
- In view of the high numbers of bacterial colonies, gram positive and negative cocci and bacilli in the first 18 patients, we added another arm to the study, with masks washed by us and cultured again for residual bacterial and fungal growth.

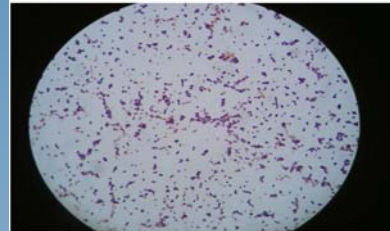
## RESULTS

- Total number of colonies measured at 48 hours - Counts are reported from the swab on the inside surface of the interface:
 

1-11 colonies per plate	31%
100-500	21%
>2000	48%
- There was no significant correlation of colony counts with reported frequency of cleanings.
- There was a correlation with mask age; older masks grew copious amounts of bacteria and fungal.
- The type of interface was not a factor, but numbers were small (9 full face, 11 nasal, and 4 nasal pillows); the inside of the mask was the most reliable source of organisms.
- Overall there was a high level of bacterial growth from CPAP masks. It consisted of the normal types of skin flora including gram positive cocci with some gram positive and negative rods, yeast, and gram negative cocci (all benign except for 2 patients that had *Staph aureus* isolated).
- No patients reported more colds since CPAP, but 8 complained of nasal congestion.
- Patient Reported Cleaning Frequency:
  - 29% nightly, 33% twice/week, 25% 1-4 times/month, and 12.5% never
- Age of Interface:
  - 1-3 months 8 Patients, 4-6 months 5 PT, 6-12 months 7 PT, and > 1 year 4 PT
- Compliance data had nightly usage at 0.68 to 11.7 hours. There was good agreement among high objective usage patients > 6 hours, but poor agreement in low usage patients (<4 hours), between objective and subjective compliance.



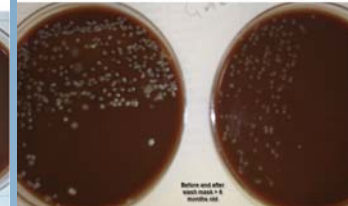
Mixed flora, gram negative and positive with occasional yeast



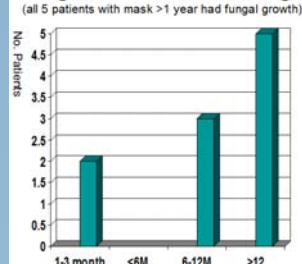
Culture before and after Rewash in Dilute Dish Soap



Culture of Mask > 6 months old Before and After Rewash



Fungal Growth and Mask Age (all 5 patients with mask > 1 year had fungal growth)



Fungal Growth



## Does severity mean more careful cleaning?



## Older masks have more gram negative growth



## CGI SCORES versus Compliance (CGI is 7 point validated scale to measure improvement)

Improvement Level	Objective Compliance average	hrs
Very much improved = 3	7.3	hrs
Much improved = 10	6.78	hrs
Slightly improved = 11	4.84	hrs

## DISCUSSION

- Microbes that colonize the skin are often harmless, but when the balance of the skin environment changes, several genera of aerobes and anaerobes can cause infections.
  - 1. Gram positive cocci-*Staph epidermidis*, *Staph aureus*, *Micrococcus*, *Streptococcus* are facultative anaerobes that may invade the skin and produce damaging exotoxins.
  - 2. Gram positive bacilli cause hair follicle and sweat gland infections.
  - 3. Gram negative bacilli and *Pseudomonas* grow profusely on organic compounds such as sweat.
- Hand washing with soap is accepted as the best way to prevent spread of viruses and bacteria and is the core of most infection control programs. The same principles should apply to CPAP equipment.
- We found a high incidence of bacterial and fungal mask contamination in our group of CPAP users. The patient's reported frequency of cleaning and severity of apnea did not seem to be as important a factor as the age of the equipment.
- There is a phenomenon noticed in other medical equipment where a slow build up of a "biofilm" of microscopic debris, adheres to latex and silicone, and is used in catheters and other types of medical equipment, rendering them difficult to fully disinfect. This may be what is happening to our older CPAP interfaces.

## CONCLUSION

- We need to pay more attention to the care and cleanliness of CPAP interfaces, in contact with the skin, mouth, nasal airway, and then used repeatedly for months, even years. Patients may not be able to understand instructions without reinforcement by respiratory therapists.
- Our "good patient" group had high compliance and high CGI scores, but still scored low in cleaning frequency and efficacy.
- There was a high incidence of bacterial growth as well as fungi and occasional yeast - all plates had positive growth.
- The older interfaces had significantly more fungi and overall higher colony counts, and more diversified bacterial populations
- Washing the interfaces with soap or antibacterial wash just before plating markedly decreased the bacteria count
- However in interfaces > 6-12 months we could not reduce the counts adequately by repeat washing and we speculate the silicone surface may become resistant to disinfection over time.
- This pilot study should be continued in a larger group of patients to verify our results and explore whether specific types of interface are more susceptible to contamination, and establish the ideal life span of a CPAP interface. A larger group would supply predictive data on the incidence of oral pharyngeal and upper respiratory infection possibly related to mask age.
- The preliminary data suggest we should be insisting on regular cleaning and mask changes every 6 months. Patients need to be better educated on the importance of CPAP mask maintenance.