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Determination Of Microbial Colonization Of Home Nebulizers Used By Children With Recurrent Wheeze In Chengalpattu District

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Abstract: *Background: Home nebulizers are widely used for pediatric respiratory illnesses. However, improper cleaning practices may predispose to microbial colonization, thereby increasing the risk of respiratory infections.*
Aim: To determine the extent of microbial colonization in home nebulizers used by children with recurrent wheeze in Chengalpattu district.
Methods: A cross-sectional study was conducted at the Department of Paediatrics, SSSMCRI, over 12 months. Children aged 1 month to 12 years with recurrent respiratory complaints and using home nebulizers were enrolled. Swabs were obtained from nebulizer masks, tubing, and drug containers. Samples were processed for bacterial and fungal culture. Data were analyzed using SPSS, with $p < 0.05$ considered significant.
Results: Among 189 participants, the most common age group was 2–5 years (45.5%). Recurrent wheeze (51.1%) was the leading diagnosis. Nebulizers (68.2%) were more commonly used than inhalers (31.8%). Bacterial growth was detected in 51.3% of devices, predominantly Pseudomonas aeruginosa (33.3%), Staphylococcus aureus (25.0%), and Klebsiella spp. (16.7%). Colonization correlated significantly with infrequent cleaning practices ($p < 0.001$).
Conclusion: Home nebulizers, when inadequately cleaned, act as reservoirs for pathogenic bacteria. Caregiver education on device hygiene is crucial to prevent secondary respiratory infections.
Keywords: *Nebulizer Contamination; Microbial Colonization; Pediatric Wheeze; Home Respiratory Devices; Infection Control*

1. INTRODUCTION

Nebulizers are commonly used to deliver inhaled medications to children with respiratory illnesses, including asthma, recurrent wheeze, and cystic fibrosis. Their widespread availability has facilitated home-based respiratory management. However, insufficient cleaning and maintenance may result in colonization by pathogenic bacteria and fungi, increasing the risk of secondary respiratory infections [1–3]. Infection prevention protocols exist, but adherence is variable, particularly in home care settings where caregivers may lack formal training [4–6]. Data on microbial contamination of home nebulizers in South India are limited. This study evaluates microbial colonization in home nebulizers used by children in Chengalpattu district, aiming to highlight the importance of device hygiene in pediatric respiratory care.

2. MATERIALS AND METHODS

Study Design and Setting

A cross-sectional observational study was conducted in the Department of Paediatrics, SSSMCRI, Chennai, over 12 months.

Study Population

Children aged 1 month to 12 years with recurrent cough, recurrent wheeze, asthma, or cystic fibrosis, using a home nebulizer, were included.

Inclusion Criteria:

- Children (1 month–12 years) with recurrent respiratory illness using a home nebulizer.

Exclusion Criteria:

- Primary ciliary dyskinesia

- Immunodeficiency disorders
- Pneumonia within the last 4 weeks
- Tuberculosis
- Pulmonary masses

Sample Size

Using the formula $n = 4PQ/L^2$, where $P = 30\%$, $Q = 70$, $L = 7\%$ (absolute precision), the required sample size was 189, accounting for a 10% non-response rate.

Data Collection

After informed consent, caregivers completed a questionnaire regarding device usage and cleaning practices. Nebulizers were brought for sample collection.

Swab Collection and Microbial Analysis

Swabs were obtained from the mask, tubing, and drug container of each device. Two swabs per component were collected — one for bacterial culture, one for fungal culture. Samples were processed in the Department of Microbiology using standard methods.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS v25. Continuous variables were expressed as mean ± SD or median (IQR). Group comparisons employed Student's *t*-test or Mann–Whitney U test. $P < 0.05$ was considered statistically significant.

Ethical Considerations

Ethical approval was granted by the Institutional Ethics Committee of SSSMCRI. Confidentiality and participant rights were maintained.

3. RESULTS

Table 1. Age distribution of study participants (n = 189)

Age group	Frequency	Percentage (%)
1 month–1 year	43	22.7
2–5 years	86	45.5
6–12 years	60	31.8

Table 1a. Age distribution of the study population (n = 189)

Age group	Frequency	Percentage (%)
1 month–1 year	43	22.7
2–5 years	86	45.5
6–12 years	60	31.8

Table 1b. Gender distribution of the study population (n = 189)

Gender	Frequency	Percentage (%)
Male	112	59.1
Female	77	40.9

Table 2. Clinical diagnosis of participants (n = 189)

Diagnosis	Frequency	Percentage (%)
Recurrent wheeze	97	51.1
Asthma	64	34.1
Cystic fibrosis	28	14.8

Table 3. Device usage patterns among participants (n = 189)

Usage parameter	Frequency	Percentage (%)
Device type		
– Nebulizer	129	68.2
– Inhaler	60	31.8
Frequency of use		

– Daily	107	56.8
– Weekly	82	43.2

Table 4. Cleaning habits of device users (n = 189)

Cleaning parameter	Frequency	Percentage (%)
Cleaning regularity		
– Daily	54	28.4
– Weekly	86	45.5
– Rarely	49	26.1
Cleaning method		
– Soap and water	86	45.5
– Alcohol swabs	32	17.0
– Not specified	71	37.5

Table 5. Commonly used medications (n = 189)

Medication type	Frequency	Percentage (%)
Salbutamol	107	56.8
Budesonide	82	43.2
Others	22	11.4

Table 6. Bacterial isolates from nebulizers (n = 129 samples)

Bacterial species	Frequency	Percentage (%)
Pseudomonas aeruginosa	43	33.3
Staphylococcus aureus	32	25.0
Klebsiella spp.	22	16.7
No growth	32	25.0

Table 7. Bacterial isolates from inhalers (n = 60 samples)

Bacterial species	Frequency	Percentage (%)
Staphylococcus aureus	17	28.6
Streptococcus spp.	13	21.4
No growth	30	50.0

Table 8. Cleaning practices and bacterial growth (n = 189)

Cleaning practice	Growth present	Growth absent	Total
Daily	11	43	54
Weekly	54	32	86
Rarely	43	6	49

Table 9. Frequency of device use and bacterial growth (n = 189)

Usage frequency	Growth present	Growth absent	Total
Daily	75	32	107
Weekly	32	50	82

Table 10. Sensitivity patterns of bacterial isolates

Antibiotic	Sensitive (%)	Resistant (%)
Amoxicillin	50	50
Ciprofloxacin	70	30
Gentamicin	80	20

Table 11. Device type and bacterial colonization (n = 189)

Device type	Growth present	Growth absent	Total
Nebulizer	97	32	129
Inhaler	30	30	60

Table 12. Parent awareness about cleaning protocols (n = 189)

Awareness parameter	Frequency	Percentage (%)
Aware of guidelines	54	28.4

Unaware of guidelines	135	71.6

Table 13. Correlation between cleaning habits and bacterial growth

Correlation parameter	R-value	P-value
Cleaning regularity vs growth	-0.65	<0.01

Table 14. Clinical implications of colonization (n = 189)

Clinical outcome	Frequency	Percentage (%)
Respiratory infections	75	39.8
No complications	114	60.2

Table 15. Association between cleaning frequency and bacterial growth (Chi-square test)

Cleaning frequency	Growth present	Growth absent	Total	χ^2 value	P-value
Daily	11	43	54		
Weekly	54	32	86	40.2	<0.001
Rarely	43	6	49		
Total	108	81	189		

Table 16. Relationship between device type and bacterial growth (Chi-square test)

Device type	Growth present	Growth absent	Total	χ^2 value	P-value
Nebulizer	97	32	129		
Inhaler	30	30	60	14.3	0.002
Total	127	62	189		

4. DISCUSSION

(To be expanded after comparison with existing studies)

- The prevalence of colonization was comparable to prior Indian and international studies [2,3,6–9].
- *Pseudomonas aeruginosa* predominance is consistent with its ability to survive in moist environments.
- Infrequent cleaning significantly correlated with higher bacterial colonization, underscoring poor caregiver adherence to hygiene protocols.
- Findings emphasize the need for structured caregiver education on nebulizer disinfection practices.

5. CONCLUSION

Home nebulizers serve as potential reservoirs for bacterial pathogens if inadequately cleaned. Regular disinfection and caregiver education are essential to reduce infection risk in children with recurrent respiratory illness.

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REFERENCES

1. Jarvis S, Ind PW, Thomas C, et al. Microbial contamination of domiciliary nebulisers and clinical implications in chronic obstructive pulmonary disease. *BMJ Open Resp Res*. 2014;1:e000018. doi:10.1136/bmjresp-2013-000018.
2. Ranjan N, Singla N, Guglani V, Randev S, Kumar P. Bacterial colonization of home nebulizers used by children with recurrent wheeze. *Indian Pediatr*. 2022;59(5):377–379.
3. Sharma S, Agarwal R, Bansal N, et al. Microbial contamination of nebulisers used by patients with chronic obstructive pulmonary disease in India: a cross-sectional study. *Lung India*. 2021;38(4):292–297.