Project Title

To compare the efficacy of nebulisation therapy delivery for tracheostomised patients with or without Novel Mask Connector through experimental study

Project Lead and Members

Project Lead: Ms Lim Jia Yan
Project Members: Ma Chongyan, Qin Jing, Tang Hongyan, Vernon Chen, Evangeline Peros, Dr. Chandran Rajkumar

Organisation(s) Involved

Changi General Hospital

Healthcare Family Group(s) Involved in this Project

Medical, Nursing

Applicable Specialty or Discipline

Respiratory Therapy

Project Period

Start date: Apr 2017

Completed date: Oct 2023

Aims

The study aims to test the efficacy of the Novel Mask Connector (NVM) in enhancing nebulization therapy delivery for tracheostomized patients.

Background

See poster appended/ below.

Methods

See poster appended/ below

Results

See poster appended/ below

Lessons Learnt

Innovation has allowed our team to broaden our perspectives on how the healthcare team can provide the best services to the patients. We have learnt to collaborate with different partners such as Centre for Innovation personnel to create our prototype using 3D-printing technology. The team also had the opportunity to visit the external laboratory to guide and monitor the data collection of the novel mask connector. Other than nursing patients at bedside, there are other ways that nurses can contribute in improving the quality of services to the patients. With the work still in progress towards clinical trial, the anticipated challenges will be the unpredictable pandemic situation which may halt the progress. Our team will aim to deliver results in the safest method available.

Conclusion

See poster appended/ below

Additional Information

The innovation is still pending the next phase of undergoing clinical trial. The team aims to complete the study by the end of 2022 and scaled the innovation hospital wide by end of 2023.

Project Category

Care & Process Redesign, Quality Improvement, Design Thinking, Clinical Practice Improvement

Technology, Medtech, 3D Printing, Product Development, Prototyping Resources

Keywords

Intensivist, Tracheostomy, Respiratory Therapist, Nebuliser, 3D Printing

Name and Email of Project Contact Person(s)

Name: Ms Lim Jia Yan

Email: Jia_Yan_Lim@cgh.com.sg

To compare the efficacy of nebulisation therapy delivery for tracheostomised patients with or without Novel Mask Connector through experimental study.

Changi General Hospital
SingHealth

Team Members: Ms Wong Wei Yui, NC Ma Chongyan, NC Qin Jing, NC Lim Jia Yan, ANC Tang Hongyan, Vernon Chen, Evangeline Peros, Maxim Tan
Department: Ward 15

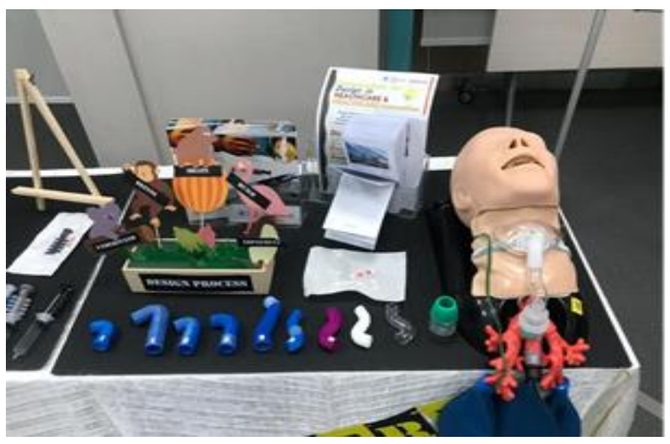
Aim(s) (Project Background)

A common challenge faced by nurses while performing nebuliser administration is difficulty in keeping the nebulisation chamber in an upright position when connected to the tracheostomy mask. The compromised medication delivery could result in the blockage of tracheostomy tube due to the inability to alleviate thick secretions. In view of the issue with the angulation to keep the nebulisation chamber upright, the team collaborated with counterparts from Changi General Hospital (CGH) Centre for Innovation (CFI) to design a Mask Connector that is able to maintain the nebulisation chamber in the optimal angulation for effective medication delivery. The project team leveraged on CFI's quick prototyping capability using 3D Printing Technology and had tested on a total of eight iterations of the Mask Connector before deriving the final design.

The study aims to test the efficacy of the Novel Mask Connector (NVM) in enhancing nebulization therapy delivery for tracheostomized patients.

Current Practice

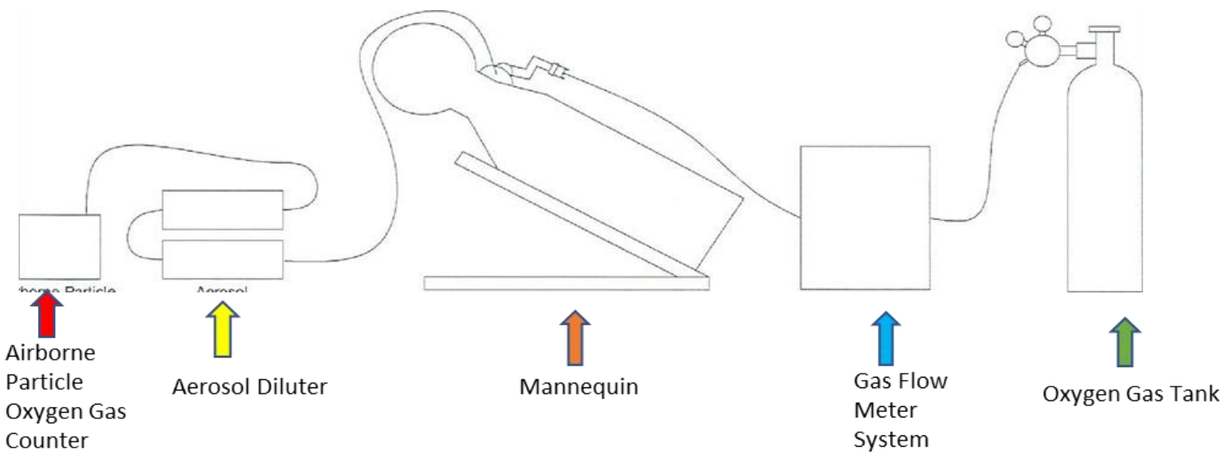
Final Prototype

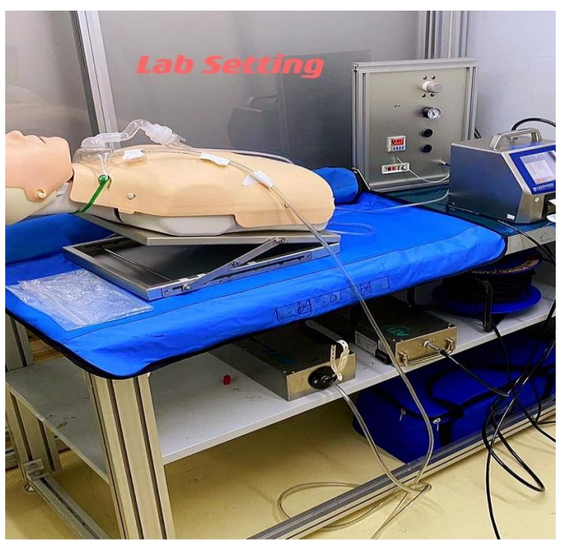


Changes (Methods)

The team conducted a comparative experimental study on the efficacy of nebulization therapy delivery with and without NVM in a controlled Laboratory environment. 3mls of normal saline 0.9% was used as test solution with oxygen rate at 6L/min. The particle count was measured with an airborne particle counter during nebulization therapy to mannequins. Different angles (15, 30, 45 angles) of Mannequin's head of position were tested over 5 minutes with 50 repetitions at each position for both with NVM and without NVM. The weight of the nebulization reservoir was measured before and after each test to determine the residual volume.

.





Measures (Results , Outcomes and Figures)

Particle Count

At 15 degrees at the end of 15 minutes, NVM yield higher amount of particle count for micron sizes of 3.0, 1.0 and 0.7 respectively and the results have strong statistical significance ($p<0.001$).

At 30-degree and 45-degree, and across all three time-points, i.e., end of 1 min, 3 mins and 5mins, the NVM produced more particle count than without NVM for particle sizes of 1.0 µm and 3.0 µm. The greatest difference was observed at the end of 1 min for 45-degree ($0.33 \times 10^8 /m^3$, 95% CI: $8.65 \times 10^8 /m^3$ to $17.27 \times 10^8 /m^3$, $p=0.01$).

Residual Volume

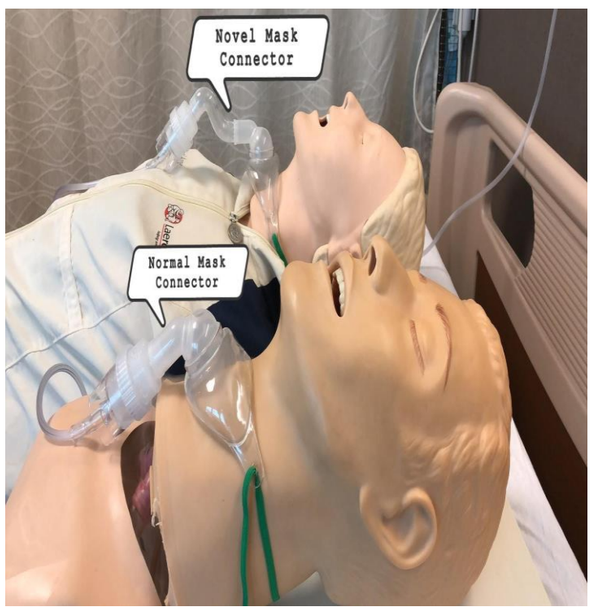
At the end of 5 mins, the mean difference for the residual volume in the NVM vs without NVM groups was marginal. At 30 degrees, the residual volume in the tests conducted using without NVM was significantly lesser than NVM, with p-value <0.001 and a difference of 0.32g (0.32mls).

Residual Volume: Descriptive for data collected

Degree	Variable	Mean (SD)	Min – max
15	Before	25.39 (0.24)	24.51 – 25.92
	After	24.17 (0.27)	23.16 – 24.87
	Residual (before - after)	1.22 (0.16)	0.69 – 1.85
30	Before	25.5 (0.25)	24.3 - 26.01
	After	23.96 (0.32)	22.89 - 24.6
	Residual (before - after)	1.53 (0.32)	0.35 - 2.53
45	Before	24.77 (0.37)	24.12 - 25.72
	After	22.85 (0.63)	22.08 - 24.31
	Residual (before - after)	1.92 (0.37)	1.10 - 2.74

Residual Volume: Residual volume between the group

Degree	Experiment (n=50)	Control (n=50)	Difference (95% CI) (Experiment – control)	P value
15				
Mean (SD)	1.19 (0.16)	1.24 (0.16)	-0.04 (-0.11, 0.02)	0.160
Min – max	0.70 – 1.85	0.69 – 1.84		
30				
Mean (SD)	1.37 (0.27)	1.69 (0.29)	-0.32 (-0.43, -0.21)	<0.001
Min – max	0.35 – 1.88	1.15 – 2.53		
45				
Mean (SD)	1.85 (0.43)	1.99 (0.29)	-0.14 (-0.29, 0.002)	0.054
Min – max	1.10 – 2.68	1.32 – 2.74		



Conclusion

The usage of the NVM enhanced the efficacy of nebulization delivery for patient with tracheostomy. The team has file a patent application for the NVM. Moving forward, the team aims for production of NVM for clinical trial.