SpiroBooth: Innovation to mitigate COVID-19 risk in the lung function laboratory

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SPIRO™ BOOTH

KK Women's and Children's Hospital
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Introduction

Spirometry is a common pulmonary function test performed worldwide to diagnosis and manage patients with respiratory conditions. It involves patient forcefully exhaling air into a mouthpiece and hence is considered an Aerosol Generating Procedure[1] (AGP). Given the high risk of COVID-19 transmission, spirometry testing in lung function laboratories worldwide, had to be greatly reduced or ceased with the evolving COVID-19 pandemic. Resuming spirometry has been operationally challenging in most lung function laboratories across the world.

Revised workflow for spirometry at KK Women's and Children's Hospital (KKH) during early phase of COVID-19 pandemic:

1) Technologists must conduct Spirometry in full Personal Protective Equipment (PPE)
2) Spirometry have to be done in isolation rooms & and the rooms needed through disinfection after each procedure.

Negative Impact:

1) Poorer patient and staff experience and well-being.
2) Impaired ability to demonstrate the technique and communicate with children, as the technologist if in full PPE .
3) Reduced slots due to higher turnaround time & limited rooms
4) Cost of PPE
5) Delay and cancellations of spirometry, resulting patient dissatisfaction and negative effect on care delivery.

Objective:

To develop a novel, self-contained, purpose-built booth - "SpiroBooth" to help conduct spirometry ***safely***, ***effectively*** and ***efficiently*** during COVID-19 and beyond.

Methodology

SpiroBooth. 1: AIRTECH ACP-897CH Clean Partition HEPA filter system; 2: UVC system; 3: Chair; 4: Intercom; 5: stainless steel base for the clip-on height adjustable holder for the spirometer mouthpiece (optional); 6: spirometer; 7: holder tray; 8: PC monitor; 9: UVC disinfection system control panel.

A team comprising of respiratory physicians, lung function technologists, infectious disease specialists; and administrative and engineering experts were put together to execute this project between Jun 2020 to Jan 2021.

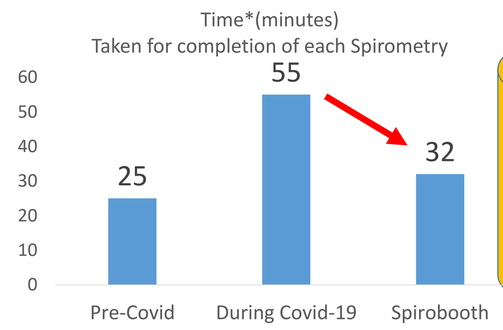
Booth specification and validation tests were carefully designed according to clinical requirements and workflow.

Patient feedback (n=80) and a time-motion study (n=30) were performed over 3,136 patients to evaluate the effectiveness of the setup compared to doing spirometry in the pre-COVID-19 times.

Results

The team successfully developed, validated and installed 3 SpiroBooths in the lung function laboratory and achieved three significant outcomes.

(1) Improved turn-around time to meet the demand for spirometry tests as in the pre-COVID period



41% decrease in turn-around time

	Total no of Spirometry Done in KKH
2019 (pre-covid)	3516
2020 (Covid, without SpiroBooth)	2038
2021 (Covid, with SpiroBooth)	2799

37.3% increase in capacity with use of Spirobooth

(2) Improved Safety of Spirometry conduct: Validation and safety studies

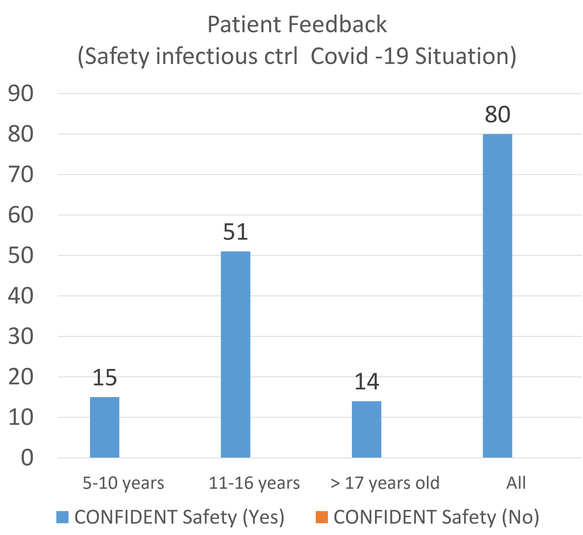
Air Filtration efficacy[2]

- Achieved 99.4% filtration efficiency for 3µm particles.
- Achieved 99.9% filtration efficacy for airborne infectious particulate matter (Bacteriophage - p22)

Ultraviolent-C sterilisation safety[2]

- Achieved 99.99% disinfection (4 log reduction) in 3.5min on high touch areas (based on surrogate target microorganism influenza A virus)
- UVC leakage through booth measured was between 0.03 to 0.13 µw/cm^2, well within the recommended safe limit of <0.2 µw/cm^2

(3) Improved operational capacity and Patient & Staff Experience



100% confidence in safety among patients.

Most patients (and parents) preferred to do the test inside the SpiroBooth.

Conclusion

SpiroBooth has helped lung function laboratory maintain operational capacity and efficiency during this COVID-19 pandemic. The improved quality of care, patient and staff experience and most importantly, safety were important outcomes of this innovation. This innovation may be adopted by lung function laboratories that face similar challenges across the world.

Reference

[1]Helgeson, S. A., Lim, K. G., Lee, A. S., Niven, A. S., & Patel, N. M. (2020). Aerosol Generation during Spirometry. Annals of the American Thoracic Society, 17(12), 1637–1639. https://doi.org/10.1513/AnnalsATS.202005-569RL

[2]Thomas, B., Teo, J. C., Teo, J. Y., Tan, K., Thoon, K. C., Teoh, O. H., Pugalenthi, A., & Chan, Y. H. (2021). SpiroBooth-innovation to mitigate COVID-19 risk in the lung function laboratory. *Pediatric pulmonology*, *56*(10), 3438–3440.