Developing a mobile model for controlled house dust mite exposure

#265

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Rationale

- Allergen exposure chambers provide a controlled environment for investigation of allergic disease.
- Multi-site clinical trials of house dust mite (HDM) allergy are limited by poor standardization across the small number of permanent facilities aerosolizing HDM allergen. [1]
- HDM-allergen capability is being added to a portable, reproducible naturalistic exposure chamber (the Mobile NEC) to facilitate expansion of HDM-allergy research.

Methods

- The Mobile NEC consists of an indoor tent with a carpeted floor, seating for 1-2 subjects, and allergen aerosolization and sampling equipment (**Fig 1A**).
- Milled spent HDM culture (*D. pteronyssinus*; D_{10}=3.6µm; D_{50}=10.6µm; D_{90}=24.5µm) was dispensed into the exhaust of a modified robot vacuum (**Fig 1B**) and dispersed throughout the Mobile NEC.
- 2-hr tests (n=6) were conducted with optimized parameters.
- Der p 1 from air sampled at the subject chair and the chamber center was measured using ELISA.
- Air particles were counted and sized by laser particle counter.

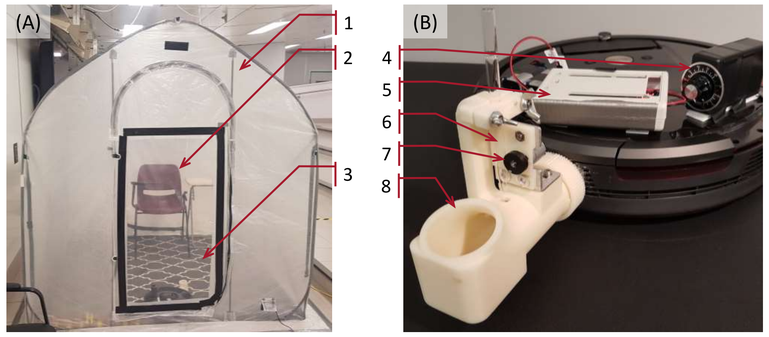

Figure 1. **(A)** Mobile NEC: **1.** collapsible tent; **2.** subject chair; **3.** low-pile carpet. **(B)** Modified robot vacuum and dispenser (patent pending): **4.** air flow controller; **5.** dispenser controller; **6.** dispenser pipette; **7.** vibration cam; **8.** exhaust channel.

We made a **portable device** to precisely dispense and **aerosolize dust mite feces** in a 2-person tent.

Now we can bring **clinical trials** of dust mite allergy almost **anywhere.**

Image: milled spent dust mite culture x2000 SEM

Results

- Airborne Der p 1 was stable in time, with no significant difference between averaged 1-hr samples centered at 30, 60, and 90 minutes (ANOVA, p=0.53; **Fig 2A**).
- Non-specific air particles were high initially (likely due to disturbed non-allergenic particles), but stabilized by 45 minutes (**Fig 2B**).

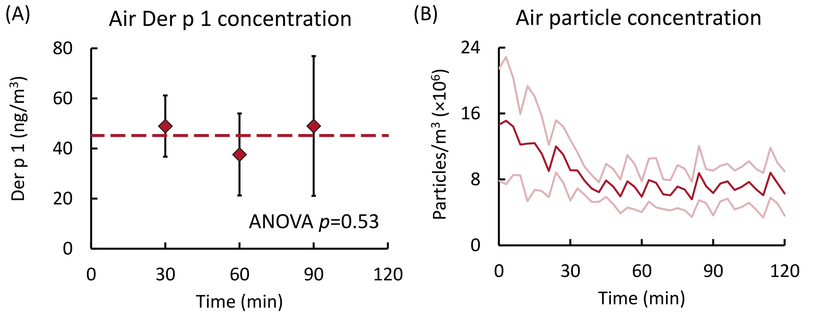

Figure 2. HDM aerosolization, inter-test mean±SD, n=6: **(A)** Der p 1 concentrations from 1-hr air samples centered at 30, 60, and 90 min. Dashed line indicates overall mean. The large variability measured at 90 min is largely due to a single high outlier; significance did not change with omission. **(B)** Air concentration of particles, D >5 µm.

Table 1. Mean Der p 1 air conc.; n=6.

Sampling Location	Mean (SD) Der p 1
Subject chair	36 (12) ng/m³
Chamber center	45 (16) ng/m³

Test-paired mean Der p 1 at chamber center and subject chair were not significantly different (paired t-test, p=0.2, n=6; **Table 1**).

Conclusions

- The Mobile NEC offers controlled, repeatable HDM exposure.
- The mobile model should facilitate multi-site clinical trials.
- Clinical validation is planned for 2023.

References: [1] Pfaar O., *et al.* Technical standards in allergen exposure chambers worldwide – an EAACI Task Force Report. Allergy. 2021; 76(12):3589–3612.

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