

A Modified Inhaler for Oral Vaccine Delivery

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Identifying the Problem

Typical Injection Vaccines are:

- Painful
- Scary (draw blood)
- Hard to transport
- Difficult to dispose of
- Not suitable for those with certain bleeding disorders

Current Alternatives are:

- Invasive
- Unpleasant
- Unable to be Self-Administered





Creating a Solution

- **Benefits:**
 - Painless
 - Easy to use
 - Less wasteful
 - Easy to transport
 - Potential use in disease eradication
 - **Concerns:**
 - People with certain conditions are not advised to take oral vaccines of any kind.
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The Modified Inhaler for Oral Vaccine Delivery

- Composed of an external shell with a built in actuator and a canister containing the vaccine
- As effective as nasal vaccines
- Comfortable and accessible
- Estimated cost to consumer - \$50

The Canister

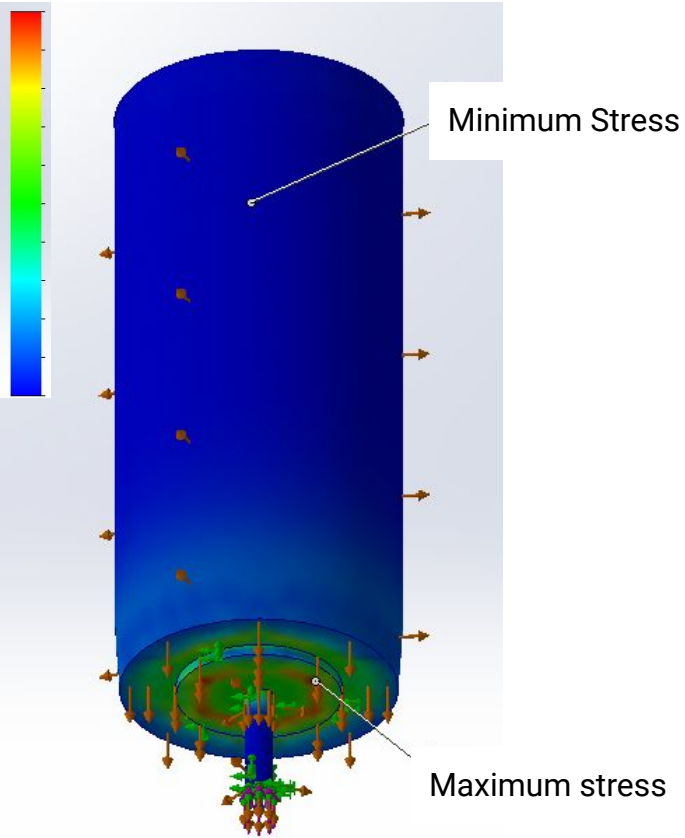


Figure 1: *Stress Profile of Pressurized Canister*

Bursting Pressure (atm) vs. Canister Wall Thickness (mm)

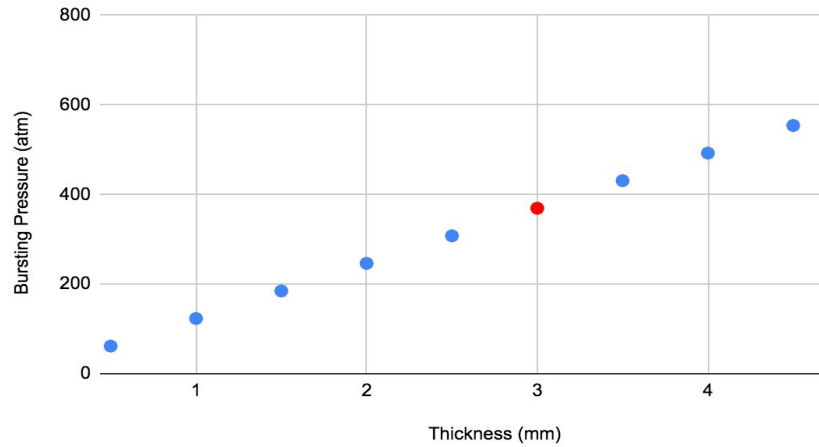
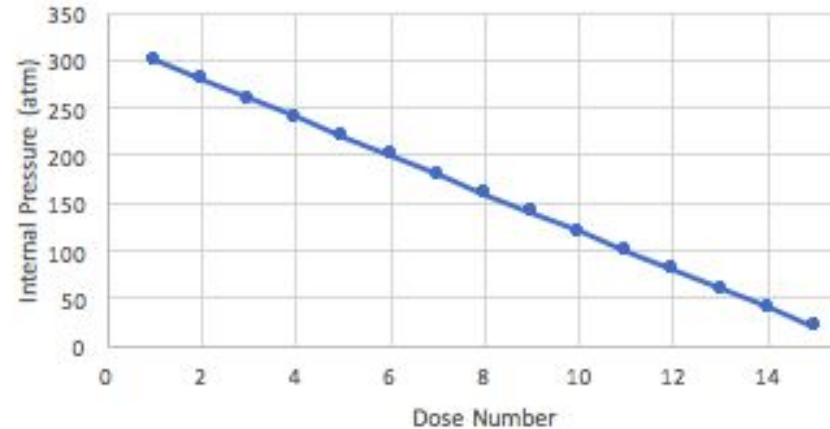


Figure 2 (left)

Figure 3 (right)

Internal Canister Pressure Over Dosage Range



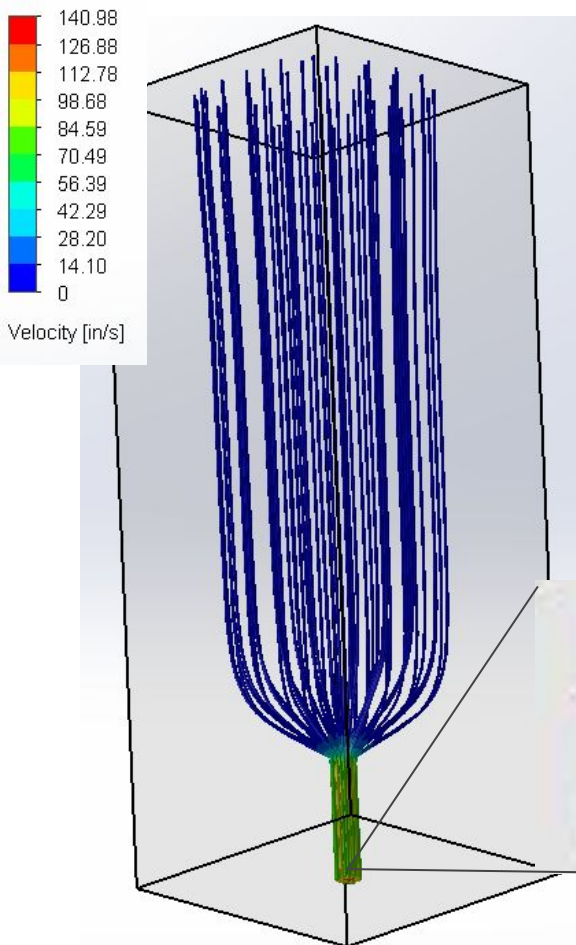


Figure 4: Velocity profile of the first administered dose



Figure 6 (right)

Fluid Density Over Dosage Range

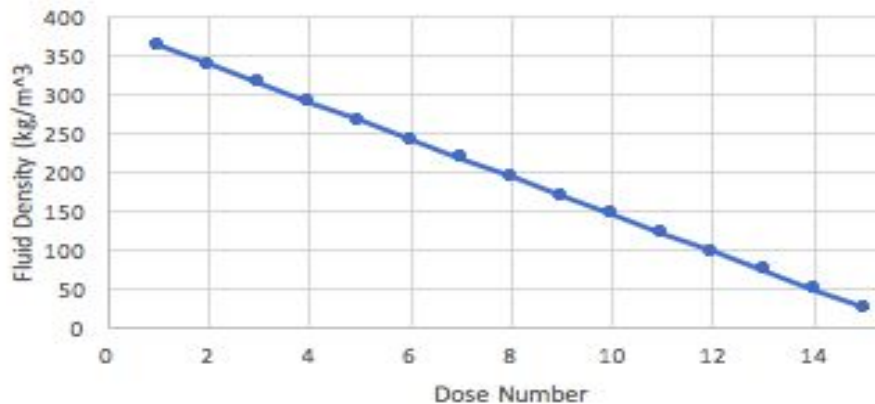
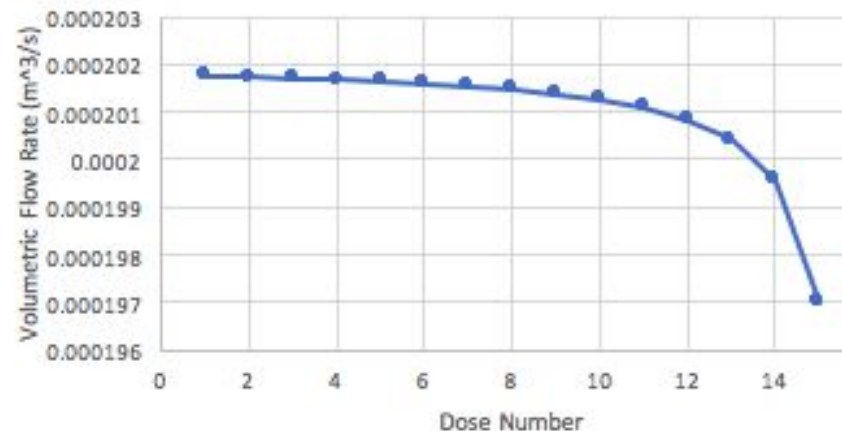


Figure 5 (left)

Volumetric Flow Rate Over Dosage Range



The Shell and Actuator

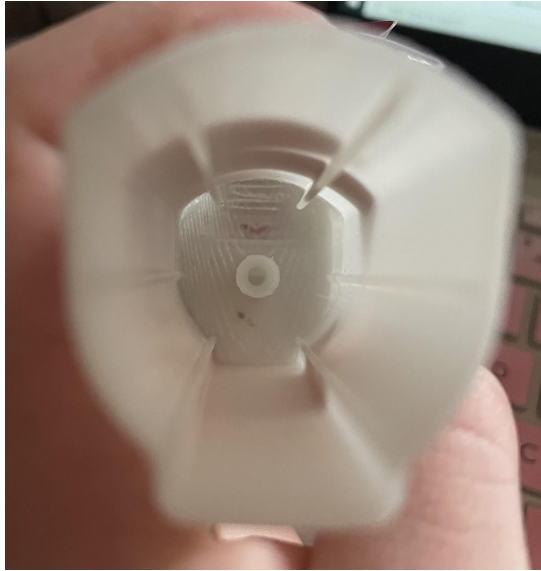


Figure 7: *Inside view of the Shell and Actuator*

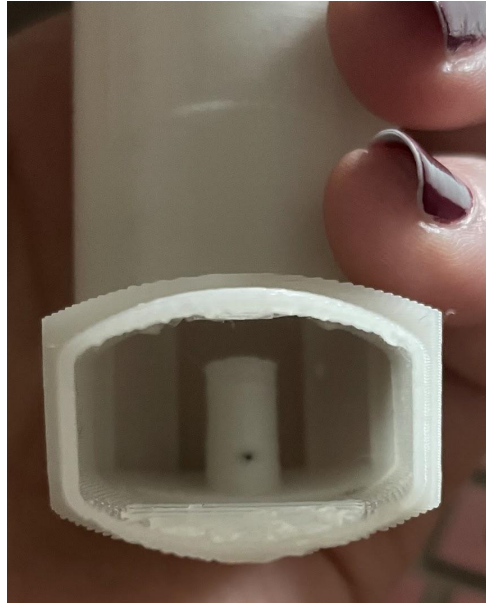


Figure 8: *Mouthpiece view of Shell and Actuator*

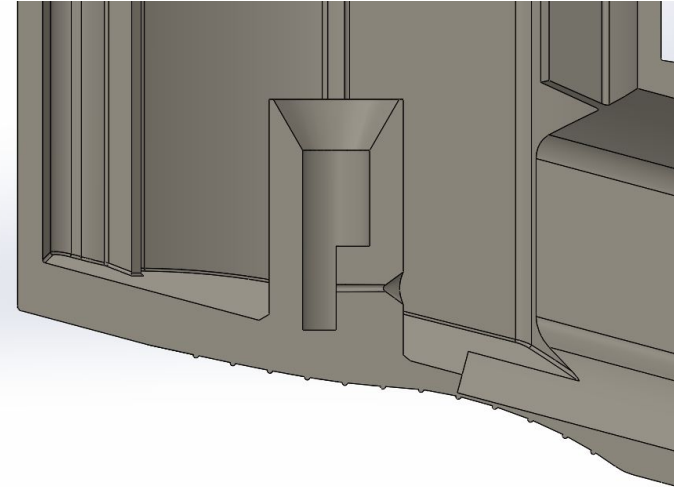


Figure 9: *CAD model of actuator*

Determining Droplet Size

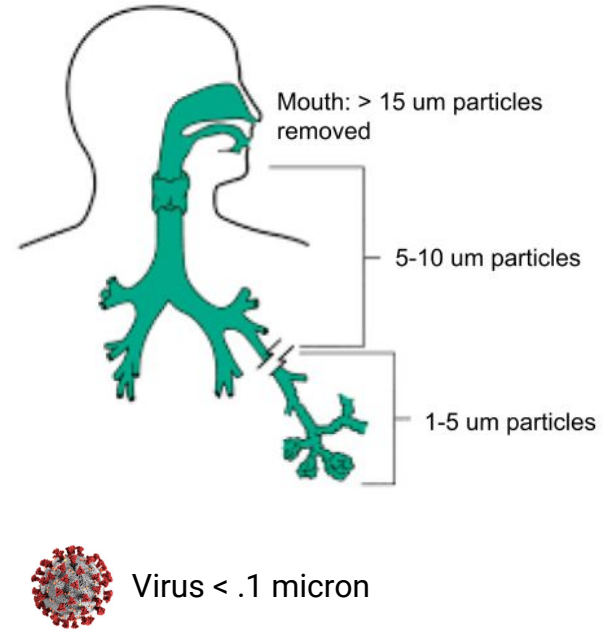
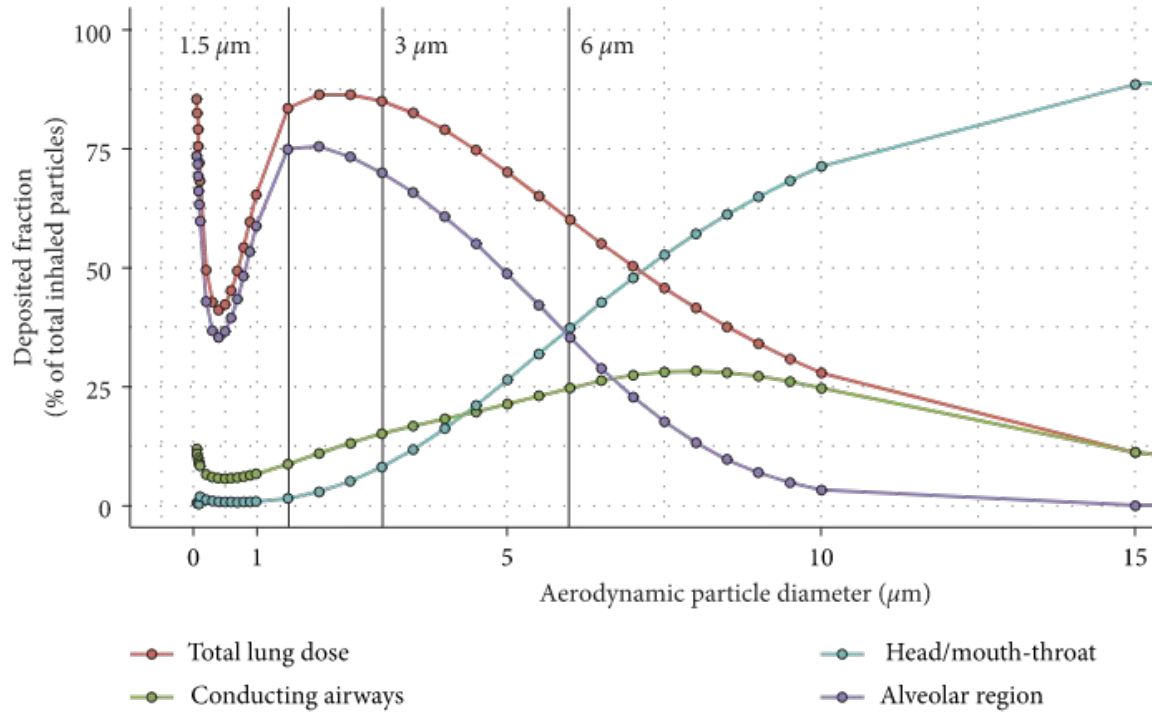


Figure 10: Particle size-dependent deposition stratified by respiratory tract region

Measuring Droplet Size

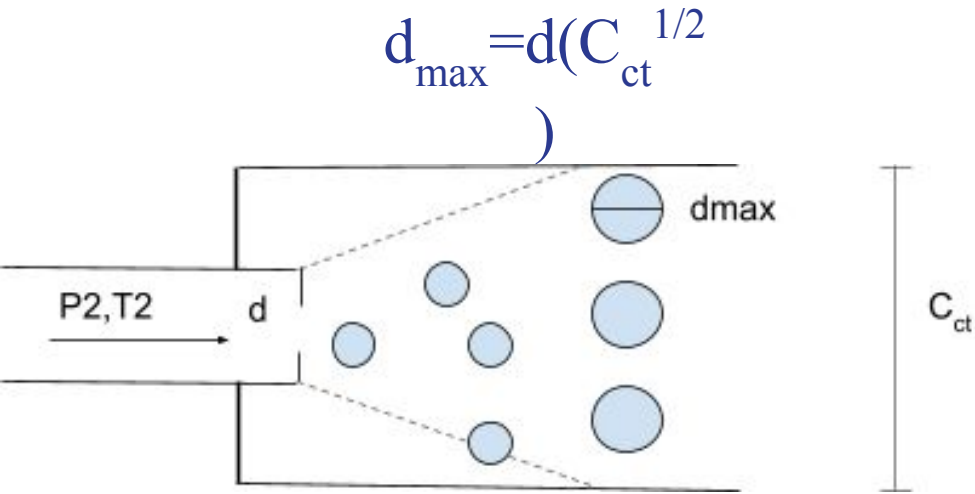


Figure 11: Mathematical model using desired droplet size to find actuator nozzle diameter

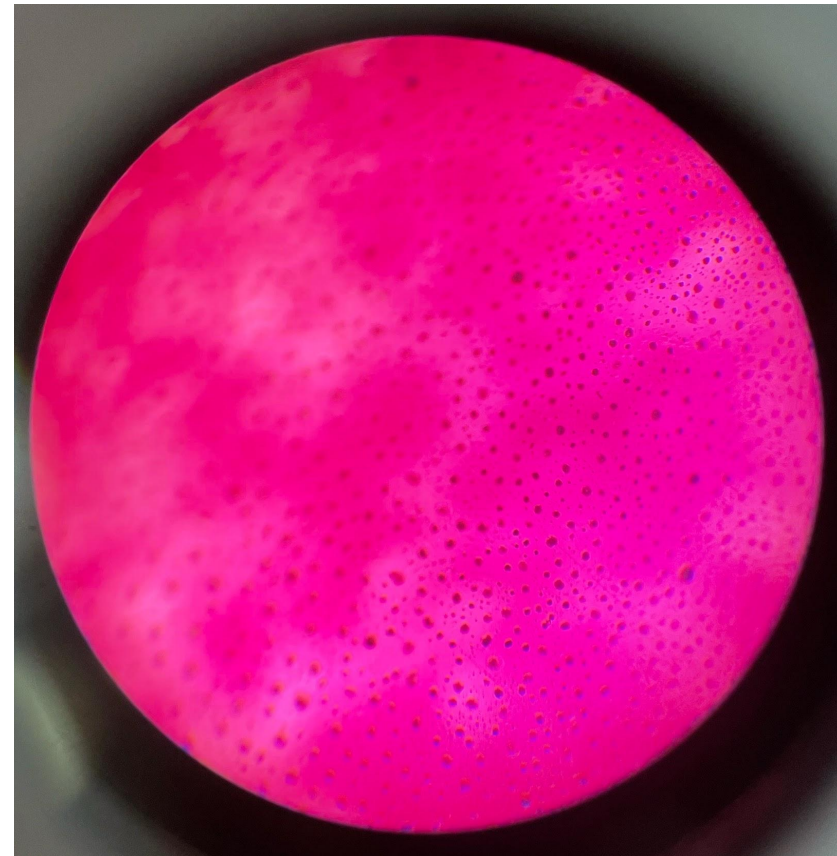


Figure 12: Droplet Spray Test

Conclusions



Oral Inhalable Vaccines can painlessly protect you and your family!

Our product will contribute to healthy communities by making vaccinations less daunting, while also cutting down on workplace injuries and hazardous environmental waste.



Thank You

References

<https://www.immunize.org/catg.d/p3085.pdf>

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5492461/>

<https://www.sciencedirect.com/science/article/pii/S0378517319300948>

<https://www.semanticscholar.org/paper/Principles-of-metered-dose-inhaler-design.-Newman/73f7ae1913d4c45f5c840c09bea0d285a2038797>

https://www.drugfuture.com/Pharmacopoeia/usp38/data/v38332/usp38nf33s2_c601.html

<https://www.alamy.com/stock-photo-profile-view-of-a-kid-using-an-asthma-inhaler-103781310.html>

<https://www.westchesterhealth.com/blog/6-tips-for-maintaining-a-happy-healthy-family/>

https://www.researchgate.net/figure/Total-and-regional-deposition-fractions-DFs-of-aerosol-particles-in-the-range-1-1-000_fig4_258501186

<https://www.aarc.org/wp-content/uploads/2018/01/aerosol-guide-for-hep-3rd.pdf>

<https://www.hindawi.com/journals/crj/2018/2732017/>