At-Home Multi-Disease Diagnostic Device via Vacuum Assisted Nasopharyngeal Mucus Collection

Jackson Barrett, Beulah Dadala, Abram Tapia
2015 SIMR Bioengineering Bootcamp, Stanford University

Introduction
Approximately 10% of all doctor’s visits in the US are unnecessary in that they do not result in treatment plans or specialist referrals but instead, involve recommendations of self-implementable treatments. This waste in resources amounts to an overwhelming $5.2 billion annually in the US alone. With our diagnostic device and information base, patients who have serious or physician-treatable illnesses will have a protocol that can direct them to seek proper medical attention. Those with less serious or personally treatable conditions such as viral infections, can avoid unnecessary physician consultations, thus reducing the waste of time, money and resources that accompanies these non-essential doctors visits.

Need Statement
We sought to create an affordable, non-invasive, and easily interpretable at-home test that can accurately diagnose four common respiratory diseases (Influenza A, Influenza B, Adenovirus and RSV), in order to reduce unnecessary visits to the doctors office and the burden these visits impose on the healthcare system.

Testing
1) When you have a sinus disease...
   ...You can use our product!
   Attach the cache and make sure the tip is secure...
   ...insert it in your nose...
2) To collect a mucus sample.
   Unscrew Cache and insert tests.
   Agitate cache to expose sample to test strips and match results with accompanying Directives.

How it works
Our device is capable of diagnosing patients and advising those with viral infections that do not require physician intervention to instead implement other easily executed treatment plans. As a result, we have decided to have a two-part prototype:
a. The first part includes designing a battery-operated nasal aspirator to test for four viral diseases: Influenza A and B, RSV, and Adenovirus.
b. The second part of our prototype is an information base where patients receive advice about their diagnosis results.

Acknowledgments
We would like to thank SIMR and the Bioengineering Department for providing us with this opportunity. We would also like to thank Dr. Xavier León. This project would not have been possible without the help of our teaching assistants Heather Rogan, Allison Mateo, Elaine Ng, Courtney Gegg, and James Kintzing; and our mentors Colleen Rhoades and Akshay Maheshwari, and our Principal Investigator Dr. Ross Venook. Thank you to the Amgen Foundation for supporting the SIMR program. We are grateful to Tyler from Stanford’s Product Realization Lab for providing Solidworks expertise and making this project a reality.

Conclusion/Future Steps
Should this product be commercialized, it has the potential to eliminate unnecessary physician consultations. Patients now have a one-stop-shop from test to diagnosis to treatment options in one product. We are yet to develop an interactive online information base and smartphone application that guide patients through their test results. These tools will be modeled for Influenza A, Influenza B, RSV & Adenovirus. This project can be further expanded in the future by adding additional diseases to the database along with their corresponding immunoassay and further refining proposed treatment plans.

References
1. Chan, S., et al., Published Journal, Year Published: 2014
2. Corstjens, P., et al., Your Health At Hand Organization Year Published: 2011
3. Loria, K., Scientists are skeptical about the secret blood test that has made Elizabeth Holmes a billionaire., Business Insider, Year Published: 2018
4. Vogell, S., Chairside Salivary Diagnostics for Oral Diseases, RDH Magazine, Year Published: 2008
7. Stanford Hospital: Esoteric Departments.
8. Vogell, S., Chairside Salivary Diagnostics for Oral Diseases, RDH Magazine.