Multiplexed Amplified Virus Etiology Network

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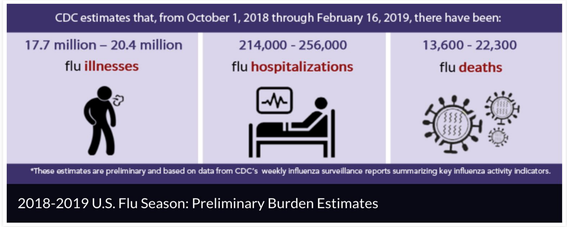
Background



Influenza is one of the leading causes of illness worldwide. Antiviral treatments are available, but they must be taken at the onset of symptoms. A rapid and accurate diagnosis can provide patients with effective treatments. The current rapid influenza diagnostic tests (RIDTs) lack reliable accuracy.

Project Objective

The purpose of MAVEN Dx is to provide physicians with a fast, reliable, and accurate diagnosis platform in order to provide patients with the appropriate treatment. MAVEN provides:

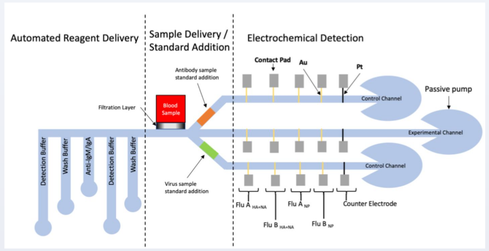
- Low cost diagnostic tool
- Non-invasive platform
- Detection of viral infection using a single droplet of human blood or sputum
- Analysis of impedance changes in the antibody coated wires using electrochemistry
- Safe, disposable, and portable diagnostic tool

Challenges & Resolutions

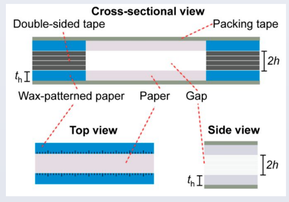
Challenge	Resolution
Optimize Flow	Experimented with different flow geometries and varied channel heights to meet requirements
Antibody Substitution	Influenza A H1 protein was substituted with BSA protein to coat the nanoparticle wires due to cost restraints.
Wire Connection	Used silver paint to ensure connectivity of wire on copper tape; had wires go all to one side of device to avoid breaking

Prototype Design

Final Mechanism

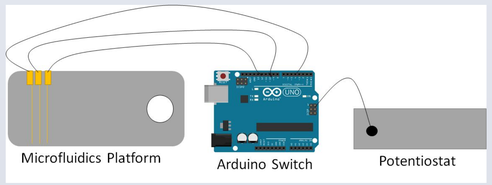


Cross-Section of Device



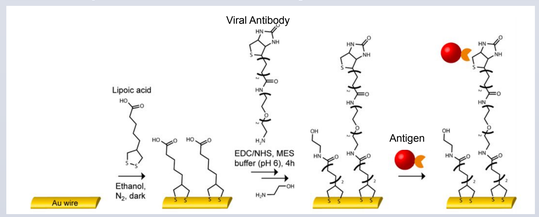
Device Housing

Signal Analysis Set-up

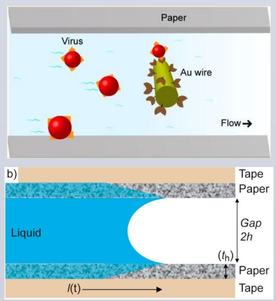


Applied Science

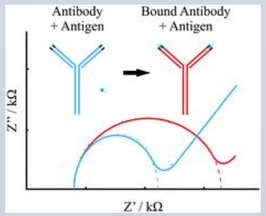
Development of Antibody Coated Electrodes



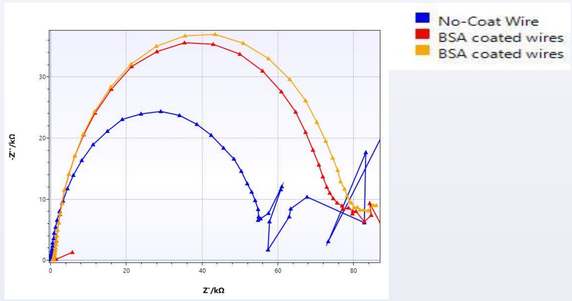
Microfluidics



Electrochemical Impedance Spectroscopy



Validation/Results

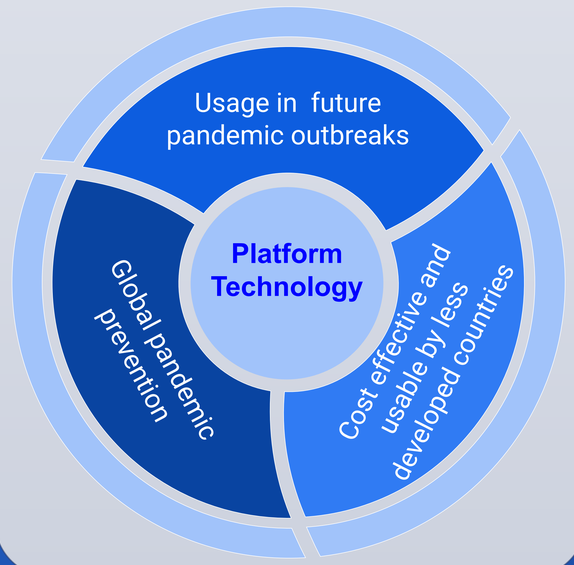


- Trials were done using PSTrace v5.8 to detect impedance change based on coating and non-coated wires
- BSA protein coated wires show higher detection in comparison to the non-coated wire.
- Antibody coated wires are expected to have higher readings to those of the BSA protein

Non-Coated Wire	24.35kΩ
BSA Coated Wire	35.59kΩ 36.96kΩ

- Data validates attachment of protein onto wire; readings validates that detection on wire

Impact



Future Goals

- Develop device into more portable platform by integrating a picostat (much smaller)

- Incorporate bluetooth capabilities to send data to personal computers
- Develop eco-friendly disposable device and housing cartridge
- Single use → Reusable device with disposable fluid catcher

Conclusions

- The overall design of MAVEN was a success with wire modification
- The device is an adequate size to allow for portability
- MAVEN provides a non-invasive diagnostic tool to medical personnel
- Electrochemical Impedance Spectroscopy was utilized to detect impedance changes within modified samples
- Due to unforeseen global events the project was placed on temporary hold with many future plans in place

References

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2. Multilayered Microfluidic Paper-Based Devices : Characterization, Modeling, and Perspectives Robert B. Channon, Michael P. Nguyen, Charles S. Henry, and David S. Dandy *Analytical Chemistry* 2019 91(14), 8966-8972
3. Rapid Flow in Multilayer Microfluidic Paper-Based Analytical Devices Channon, R.B.; Nguyen, M.; Scorzelli, A.; Henry, E.; Volckens, J.; Dandy, D.; Henry, C. *Lab Chip* 2018, 18, 793-802

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