Spring 2014
Hashemi Lab

Blood Separation and Protein/Glucose Detection Using Paper-Based Microfluidic Devices

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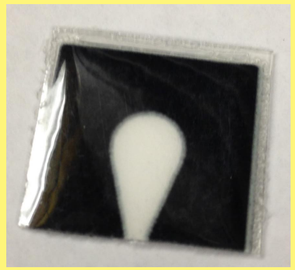
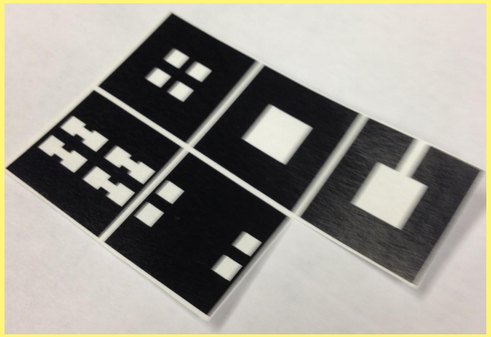
Problem Statement: Our goal is create a small, portable, easy-to-use device that can be used to test blood samples for glucose and protein levels, which are indicators of overall health. In order to do this, it is necessary for these devices to be able to: 1) gather blood in small amounts 2) split the plasma apart from the blood sample and 3) pass the plasma through assays which can produce color changes based on glucose and protein levels.

Design:

- Our paper-based microfluidic devices are printed on Whatman No. 1 chromatography paper using a hydrophobic wax-based ink.
- The combination of the two of these creates paths and chambers that the blood and plasma are allowed to pass through.
- By creating different panels with specific designs and then stacking these panels, a 3-D path for plasma and blood to follow can be created.

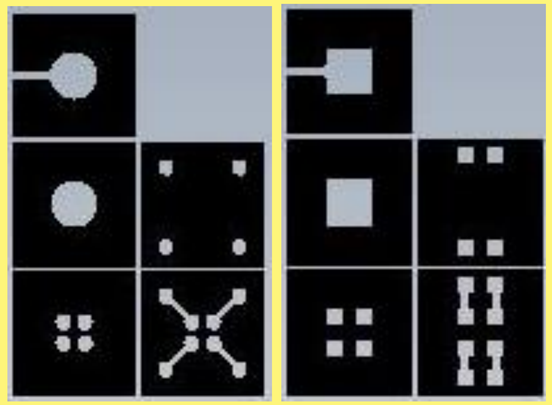


(Left) A completed microfluidic device with lamination. Blood enters via the open path on the bottom portion.



Testing:

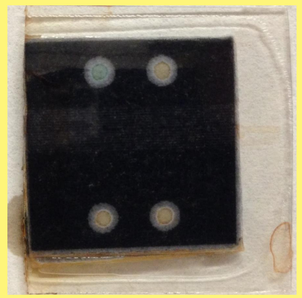
- In order for plasma to be split from the blood which enters the top panel, a separate layer of a special type of plasma separation membrane is placed between the first and second panels.
- After the plasma has been split, it comes into contact with the assays which produce the color change finally seen on the bottom layer.
- In order for the layers to remain together for the tests, all layers are sealed using a lamination process.
- As of now, synthetic blood has been used to test these devices.



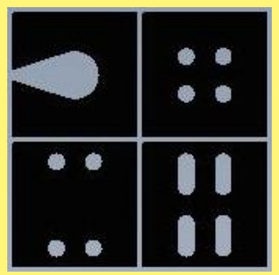
(Left) The two five-paneled designs, which, when folded, create the basis of the microfluidic devices. The third design, with only four panels, is shown below. All of these devices were designed and printed in the SolidWorks 2013 CAD program.

Results and Interpretation:

- After the plasma has flowed through the device, the color change is quantified by taking a digital picture of the bottom panel which contains the control colors and the test colors.
- The pictures are uploaded to Adobe Photoshop, where the colors are assigned values for each section and compared to known information relating color change using assays with protein and glucose levels.
- Using synthetic blood, a color change has been produced with the assays. Future tests will use human blood to look for the same results.



(Left) A device after synthetic blood has passed through it and the test is completed. Note the change in color on the upper left chamber. The other chambers are controls.



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