



CALIFORNIA STATE SCIENCE FAIR

2017 PROJECT SUMMARY

Name(s) Morgan M. Kopecky	Project Number S1308
Project Title Two Quantitative Colorimetric Screening Tests for the Noninvasive Detection of Type II Diabetes	
Objectives/Goals The objective of this study was to create a simple test for the early diagnosis of Type II Diabetes using a noninvasive sample. Over 30 million Americans have diabetes and 86 million have prediabetes, while 28% and 89% remain undiagnosed respectively.	Abstract Sodium concentration in sweat was identified as a novel biomarker for the detection of diabetes. Two methods to determine the levels of sodium in sweat were devised in this study. The compatibility of sodium assay kit reagents was tested with the stabilizing reagent Trehalose dihydrate. In one detection method, a sodium assay kit was miniaturized to require 40 µl of reagents, a transfer pipette and smartphone. In the second detection method, wax printing was utilized to fabricate a paper sensor. Reagents were stabilized and embedded in the test zones of the sensor to create a semi-automated paper-based screening test. Both screening tests were tested for accuracy and precision with samples containing a range of sodium concentrations. The resulting color change was quantified using ImageJ.
Methods/Materials Sodium assay kit reagents were compatible with Trehalose dihydrate. Wax printing was an inexpensive and rapid method to produce paper sensors. The paper was able to filter out contaminates from samples and the sensor and consistently absorbed 7 µl of sample. Reagents stabilized with Trehalose dihydrate maintained activity and can be stored on paper and in aqueous form. ImageJ proved to be an accurate tool to quantitatively analyze the colorimetric results of both detection methods.	Results Sodium assay kit reagents were compatible with Trehalose dihydrate. Wax printing was an inexpensive and rapid method to produce paper sensors. The paper was able to filter out contaminates from samples and the sensor and consistently absorbed 7 µl of sample. Reagents stabilized with Trehalose dihydrate maintained activity and can be stored on paper and in aqueous form. ImageJ proved to be an accurate tool to quantitatively analyze the colorimetric results of both detection methods.
Conclusions/Discussion The first detection method has a standard curve with an R ² value of .9817, costs \$1.54, requires a 5 µl sample, and generates results in under an hour. The paper sensor detection method has a standard curve with an R ² value of .9926, requires a 3 µl sample, costs \$0.25 and generates results in under one hour.	
Summary Statement This study devised two quantitative screening tests for the early detection of Type II Diabetes through the novel use of sweat sodium concentration as a noninvasive biomarker.	
Help Received Ph.D. student at UC Irvine, Neha Garg, supervised use of wax printer. Dr. Robert Edwards allowed use of his laboratory at UCI to store materials and access scientific equipment. Dr. Andres Martinez from California Polytechnic University provided guidance on paper sensor methodology and design.	