Glucometers to Detect for Heart Attack
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ABSTRACT:
Acute Myocardial Infarction (AMI), commonly referred to as a heart attack, is a disorder in which damage to an area of heart muscle occurs because of an inadequate supply of oxygen to that area leading to damage or death of cells. The damaged tissue results in a permanent loss of contraction of this portion of the heart muscle. AMI occurs in approximately 2 out of 1,000 people per year. It is a major cause of sudden death in adults. Currently there is an interest for the earliest possible determination of AMI for patients admitted to the emergency room with chest pains, both to determine which patients can be safely sent home and which need further care, and because for those who suffered an AMI, treatment with thrombolytic therapy is most beneficial the earlier after an AMI the treatment is instituted.

INTRODUCTION
Development of a cost effective, simple and efficient assay determining whether or not an AMI has taken place will greatly assist health care providers in diagnosis. To further assist the medical community it would be beneficial to package the assay into a point of care (POC) device that may be utilized in route to an emergency department or at a patient’s bedside. Of equal importance is for the device to be easy to use by nurses in the emergency room. Several proteins or markers such as Myoglobin (MB), Creatine Kinase (CK) and Fatty Acid Binding Protein (FABP), can result from the cardiac tissue injury and are released into the bloodstream immediately after the cardiac injury. The increase of concentration of these markers is used to detect AMI.

A device that measures the concentration of proteins (cardiac markers) that result from cardiac injury is developed. The device utilizes magnetic immunoassay to isolate the cardiac markers from the blood serum. Then with the aid of a glucometer, conventionally used to measure glucose concentration in the blood, the concentration of cardiac markers is measured.

MAGNETIC IMMUNOASSAY
The magnetic immunoassay utilizes a standard solid-phase enzyme linked immunoassay (ELISA). The ELISA takes advantage of the multiple epitopes that are found on the target protein, in our case the cardiac markers. A sandwich is formed by attaching two different antibodies to different epitopes on the same target antigen, which it is in our case, myoglobin (see figure 1). One antibody is attached to a solid surface of the magnetic particle, and the other is attached to a glucose molecule. The first antibodies is used for the separation of the Myoglobin from the blood sample, while the second antibody, attached a glucose molecule, is used to measure the relative concentration of myoglobin in blood stream. Attaching glucose molecules at the end of the anti-myoglobin antibody will facilitate the detection of AMI by regular glucometer.

Blood glucose concentration is measured by an amperometric system for point of care determination. In this system, the reagent strips contain a test area, which is impregnated with the enzyme glucose dehydrogenase, and two metal strips that serve as electrodes. Enzymatic action on glucose liberates an electron, which reacts with a mediator also present in the strip. The monitor in which the strip is placed applies a voltage across the electrodes, causing the mediator to be reconverted to its oxidized form. This reaction generates a current proportional to the amount of glucose present and is translated by the meter to a numeric glucose concentration.

Figure 2 shows a measurement of the electric resistance correlated with the glucose concentration. The glucose is attached to an antibody that is linked to the myoglobin. The resulted resistance from each concentration was different and inversely correlated with the concentration; the highest concentration had the lowest resistance.

Figure 1. Schematic representation of a two-site immunoassay
Figure 2: The relationship between each glucose concentrations and its average resistance