

Multiplexed Point-of-Care Blood Diagnostics

Michael C. Howland, Ph.D.; Alexander Revzin, Ph.D.

The Problem:

Blood transfusions in the countries of sub-Saharan Africa and Southeast Asia are critically important. The low standard of living and malnutrition in these countries leads to high frequency of anemia, particularly in children and women. According to the World Health Organization (WHO) 30 to 40% of women in sub-Saharan Africa have anemia and about 25% of postpartum deaths in women are related to obstetrical hemorrhages. While blood transfusions are essential, blood safety remains a major problem in the developing world. One way to make an immediate impact in improving safety of blood transfusions is to develop assays for rapid and inexpensive screening of donated blood. These countries have a particularly high prevalence of several bloodstream viral infections including human immunodeficiency virus (HIV), hepatitis C virus (HCV), and hepatitis B virus (HBV). WHO reports that blood donation screening is currently limited to ~75% in the case of HIV, ~50% for HBV, and ~19% for HCV. Enzyme-linked immunoassay (ELISA) and nucleic acid test (NAT) kits for detecting these infections have been developed and are in principle available in the developing world. However, these commercial tests remain relatively expensive and laborious, and often require expensive equipment and refrigeration of reagents. We believe that the cost, complexity and requirements of facilities/infrastructure limit wider screening of donor blood in the developing world.

Our Approach:

We propose to address these issues by developing a device capable of simple, rapid, multiplexed diagnostic screening of blood. Our device uses a microfluidic approach in combination with a novel detection scheme that eliminates the need for blood pre-treatment or multiple washing steps and can operate with very low blood volumes. Based on a single input of blood, our technology will identify blood type, T-cell count, and cytokine profiles. Chip analysis can be conducted on a simplified, scaled-down microscope coupled to a CCD camera at the point of care.

The technologies involved in the current device have broad applications in other diagnostic markets too, such as neonatal populations where low volume tests are critical. We are currently examining the commercial potential of these markets.