

Siemens Competition

Math : Science : Technology

Regional Finalist

Name: Venkata Macha

High School: Loveless Academic Magnet Program High School

Mentor: Dr. Marsha A. Moses

Project Title: *A Novel Bioelectronic Chip for Noninvasive, Versatile Cancer Detection* (Bioengineering; Biophysics)

Though accurate, current cancer detection methods are time-consuming, expensive, disease-specific, and not quantitative. To improve clinical cancer treatment, a better system for early detection is needed. Matrix metalloprotease (MMP) is an endopeptidase expressed in human urine whenever cancer is present. Thus, detecting urinary MMP can suggest tumor presence in humans. For a rapid point-of-care detection method, literature was reviewed and preliminary results were collected to develop a novel bioelectronic chip sensitive to MMP. Through multiple iterations, the bioelectronic chip was optimized for maximum conductivity in urine. Western analysis was used to validate minimal cross-reactivity in the chip, and zymography was used to validate MMP presence in urine from cancer patients. Initial tests then used the bioelectronic chip to confirm a dose-dependent curve and minimal cross-reactivity with IgG. Later tests used the chip to test urine populations from types of cancer and non-cancer patients, always revealing $P < 0.05$ differentiability of populations. ROC analysis using zymography as a control determined the chip to be 14% more accurate than ELISA. Consequently, a novel bioelectronic system has been developed to detect any cancer type non-invasively, rapidly, inexpensively, and quantitatively. Thus, early cancer detection can lead to more effective cancer treatment and save many lives.