LEMELSON-MIT

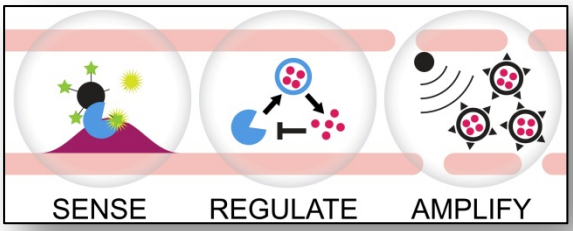
Celebrating invention, inspiring youth

Winner of the 2014 $500,000 Lemelson-MIT Prize – Dr. Sangeeta Bhatia

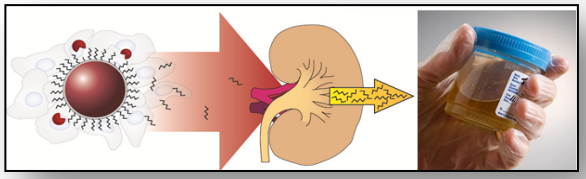
Bhatia's combined clinical and engineering perspective targets the development of miniaturized technologies to impact human health in areas ranging from drug toxicity, tissue regeneration, cancer therapy, disease monitoring and infectious disease. Her portfolio of inventions have the potential to impact patients globally.

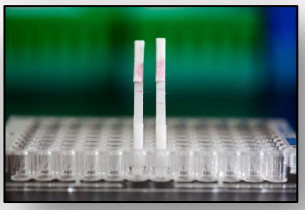
Synthetic Biomarkers that Leverage Natural Disease Processes for Diagnosis & Monitoring

Methods to improve early disease detection and monitoring are needed, especially in the developing world. Bhatia invented a sensitive, noninvasive and inexpensive detection and monitoring approach using nanoparticles to deliver enzyme substrates to diseased tissue, inducing the production of 'synthetic' biomarkers that are concentrated and shed in the urine. The test has been used to detect colorectal cancer, thrombosis and liver fibrosis progression, and, in collaboration with pharma, is being adapted to measure drug responses and cancer metastases that currently escape detection.



Bhatia invented paper urine tests for developing world applications, that are being adapted for use in a drug compliance trial. She also leveraged the power of bacterial synthetic biology in combination with probiotic vehicles to fine-tune dosing and delivery control.





Microlivers for Drug Toxicity & Infectious Disease

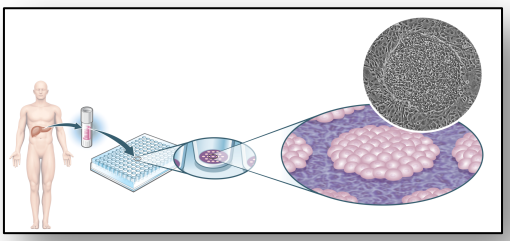


Photo credit: Hepregen

Toxicity prediction tools available today use dysfunctional human cells or animal testing, neither of which replicate normal liver metabolism. Bhatia invented a method to stabilize human liver cells in culture by borrowing techniques from the semiconductor manufacturing industry to produce patterns of single or multiple cells on surfaces. Her patterns incorporate supporting cells, inspired by native liver architecture, with precise control over cell-cell interactions.

Her group reworked the manufacturing process to be compatible with plastic devices that hold testing samples for modern high-throughput screening. This platform delivers improved predictivity of human metabolism and toxicity. Now marketed as a line of HepatoPac® products by Hepregen Corp., her microliver is the 'first in class' of a new generation of engineered tissues for predicting a variety of human responses (e.g. heart, brain, kidney) and is rapidly being adopted in the field.

Bhatia recognized an opportunity to extend the microliver platform beyond toxicity testing of drugs and environmental contaminants. She replicated Hepatitis C and Hepatitis B virus infections outside of the body and with support from the Gates Foundation, the liver-stages of human malaria. She is developing screens for drugs that block entry, clear the pathogen and assess vaccine safety.

Commercialization through Collaboration

Bhatia and her trainees have launched ten companies with more than 70 products. She is currently a co-founder of Hepregen, offering diverse lines of HepatoPac® products for drug development and toxicity testing, and Zymera, a nanocrystal technology for preclinical in vivo imaging and molecular detection.

Bhatia's collaboration with her students has also guided them through the founding of their own companies. Sienna Labs, co-founded by three of Bhatia's graduate students, is combining nanomaterials with laser sources to enhance dermatology by targeting the effects of lasers to fine structures in the skin. Cell2B, a biotechnology company co-founded by another of Bhatia's students, is developing new techniques to grow and deliver stem cells. These cells have unique properties to renew damaged tissue or organ functions.