**Docket #:** S21-208

# Genetically-encoded volatile synthetic biomarkers for breath-based cancer detection

Stanford inventors have engineered a method for breath-based cancer detection, which can provide rapid and non-invasive early cancer detection and surveillance. Analysis of volatile organic compounds (VOCs) is more reliable than current approaches for cancer detection, which may be limited by poor sensitivity, biomarker stability, and specificity. This method involves genetically encoding a tumor-specific promotor that expresses limonene, a clinically-safe VOC, in the presence of cancerous cells. Additionally, the inventors additionally present a method for VOC detection that enables several hours of sampling, which improves sensitivity by over 100-fold compared to standard VOC quantification methods. The researchers demonstrate that implanting human cancer cells with stable limonene expression in a mouse tumor model successfully enables detection of tumors as small as 5 mm. From pharmacokinetic simulations, this method is predicted to detect tumors as small as 7 mm in humans which would surpass current PET imaging detection limits.

**Stage of Development**
The inventors have demonstrated in preclinical work with cells in culture and in tumors in living mice that the VOC can be expressed and detected in metabolically engineered cells improving detection sensitivity.

## Applications

- Surveillance testing for early cancer detection

## Advantages

- Non-invasive, inexpensive, and fast method of cancer detection
- Does not require sample processing or storage
- Offers 100-fold improvement in sensitivity over current breath-based cancer-detection methods
- May enable routine monitoring via continuous VOC expression after single administration of the gene

## Publications


- Vermesh O., D'Souza A.L., Alam I.S., Wardak M., McLaughlin T., Rami F.E., Sathirachinda A., Bell J.C., James M.L., Hori S.S., Gross E.R., Gambir S.S. Engineering genetically-encoded synthetic biomarkers for breath-based cancer detection. bioRXiv 2021.


## Patents

- Published Application: WO2023010143
- Published Application: 20240319166

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