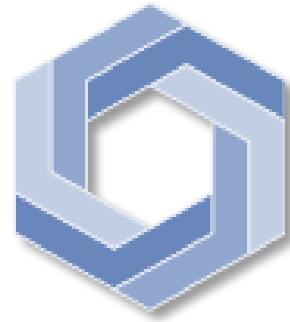


# BioMark DIAGNOSTICS INC

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## A Next Generation Company Powered by Metabolomics

[www.biomarkdiagnostics.com](http://www.biomarkdiagnostics.com)



# BioMark DIAGNOSTICS INC

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## Our Mission

To provide access to a new paradigm in cancer diagnostics using metabolomics

## Who We Are

- Oncology-focused company with advanced near-to-market diagnostic technologies
- Multiple IPs generated in detection and quantitation of metabolites
  - collectively over 20 patents in different stages and jurisdictions in progress
- Hand-picked, proven, global enterprise team of scientists, engineers and medical professionals



# ABOUT BIOMARK

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## Executive Team

- **Rashid Ahmed, MBA** – Founder, Chief Executive Officer
- **Dr. Thomas Malcolm, Ph.D** – Chief Scientific Advisor
- **Dr. Bram Ramjiawan, Ph.D** – Clinical Trial and Regulatory Expertise
- **Brian Cheng, MSc**– Chief Technical Officer
- **Dr. Kenneth Kohn, Ph.D** – Patent Attorney
- **Gina Huang, MBA** – CFO and Project Director



# ABOUT BIOMARK

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- **Research/Scientific/Clinical Team**

Dr. Daniel Sitar – Principal Scientific Advisor / Professor Emeritus, University of Manitoba

Dr. David Wishart - Professor, Depts. of Computer Science and Biological Sciences, University of Alberta

Dr. Myron L. Weisfeldt - M.D., University Distinguished Service Professor, Professor of Medicine, The Johns Hopkins Hospital

Dr. Ian C.P. Smith - Officer of the Order of Canada, PhD, DSc, FRSC

Dr. Andrew Maksymiuk - Oncologist; Cancer Care Manitoba

Dr. John Yoo - Clinical Oncologist; Co-Chair CancerCare Ontario Head and Neck; Professor Dept. of Oncology Schulich School of Medicine & Dentistry, Western Ontario

Dr. James Bond - Chief of Surrey Hospital Thoracic Surgery Team, Fraser Health Authority and Surrey Memorial Hospital

Dr. David Chen - Professor, Dept. of Chemistry, University of British Columbia

Dr. Horacio Bach - PhD, Antibody Engineering UBC

Dr. Reuven Gordon - Professor, Canadian Research Chair in Nanoplasmonics, University of Victoria

Dr. Donald Miller - Professor, Department of Pharmacology and Therapeutics University of Manitoba



# Terms - Metabolomics - Coordinates for your cellular GPS. An Emerging and disruptive technology

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- Metabolites are products or by products of the chemical interactions in every cells. Cancer cells create an abnormality in the metabolism of the cells that can cause a tumour to grow out of control.
- Metabolomics is the "systematic study of the unique chemical fingerprints that specific cellular processes leave behind specifically, the study of their small-molecule metabolite profiles.
- Metabolic profiling can give an instantaneous snapshot of the physiology of that cell.
- The metabolome represents the collection of all metabolites in a biological cell, tissue, organ or organism, which are the end products of cellular processes
- Metabolomics enhances the power and sensitivity of many clinical assays and diagnostics techniques. It is a powerful tool when used with nanotechnologies and data mining
- Biomarker is an indicator of a biological or a disease state – normal vs disease state. Is an objective measure of physiological processes or pathogenic processes or pharmacological response following a therapeutic intervention

Since 2015 there have been over 20,100 articles on metabolomics subject



# Metabolomics is Moving to the Bedside

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- Number of “approved” tests arising from **Metabolomics/Clinical Chem.** – 334
- Number of “approved” tests arising from or using **Genomics** – 130
- Number of “approved” single **Protein** tests (ELISA) – 108
- Number of “approved” tests arising from or using **Transcriptomics** – 5
- Number of “approved” tests arising from or using **Proteomics** - 1



# Value Proposition

## - Physician, Patient, Payer and Pharma Impact

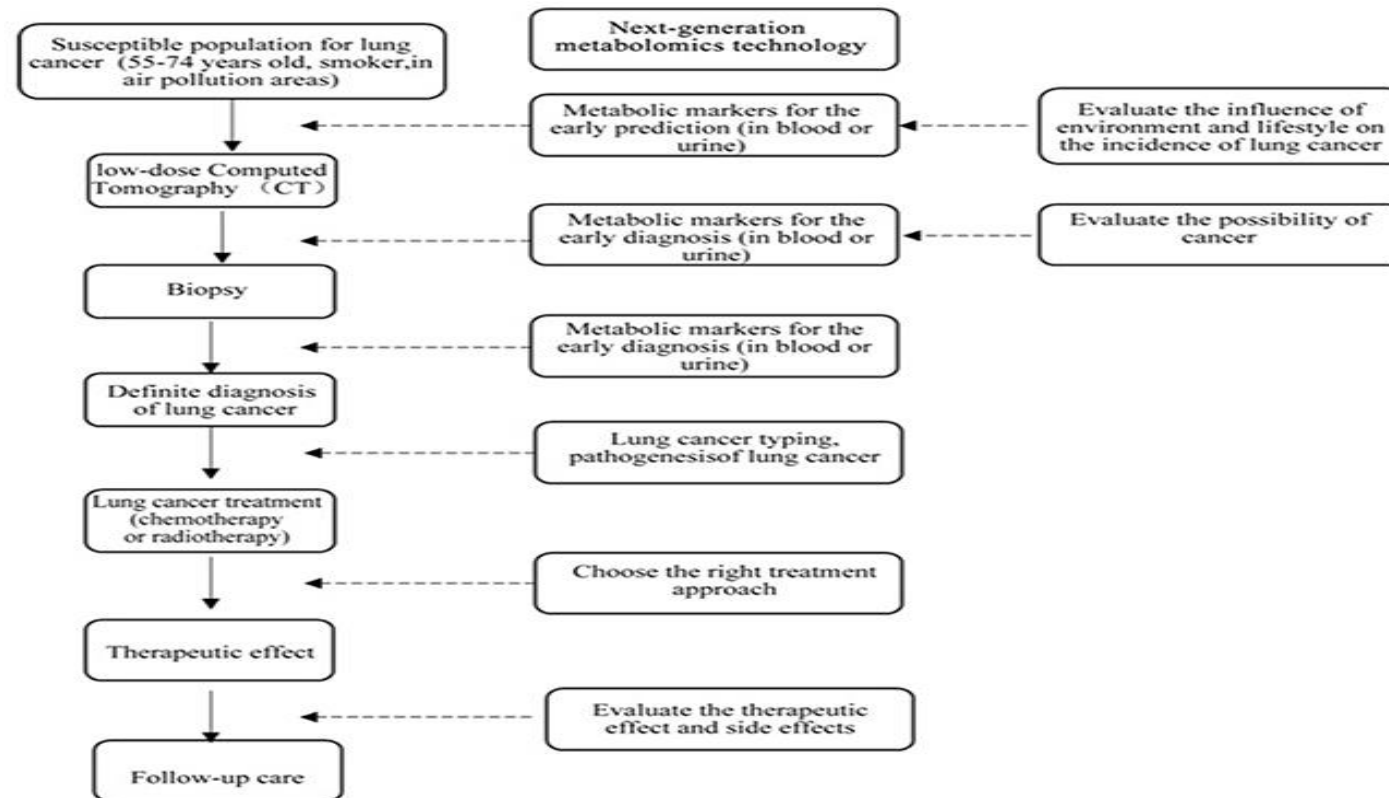
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- Provide better early detection technologies that are reliable, non invasive and cost effective to reduce later costs of treatment – drug and hospitalization costs
- Provide better tools to assess treatment efficacy earlier so as to tailor treatment – treatment costs and quality of life measures (Reduce time / cost / challenges especially for advanced staged malignant lung cancer)
- Provide a low cost routine surveillance tool to help monitor recurrence – CEA CA 125 etc.
- Potential utility as a companion diagnostic for drug discovery





# Clinical Application in Lung Cancer





# Discovery and Development of Metabolomic Assays

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Completed development and validation of **2** principle assays – Platform Play

## a). Acetyl Amantadine SSAT1 Assay

- Based on key discovery by Dr. Sitar UoM – Amantadine and SSAT1 (Linked to Polyamine pathway)
- Recently completed a clinical trial based on a total of 450 patients after gaining CTA for phase III with focus on lung and breast and cancers
- Obtained ITA (Health Canada) on internal standards for quantification using LC- MS
- Encouraging results and in process to submit application to Health Canada

## b). New lung cancer fingerprints – high performance biomarkers

- Discovered and validated markers using custom assay
- Strong ROC (Receiver Operating Curves)

***Both discoveries supported by multiple patents***



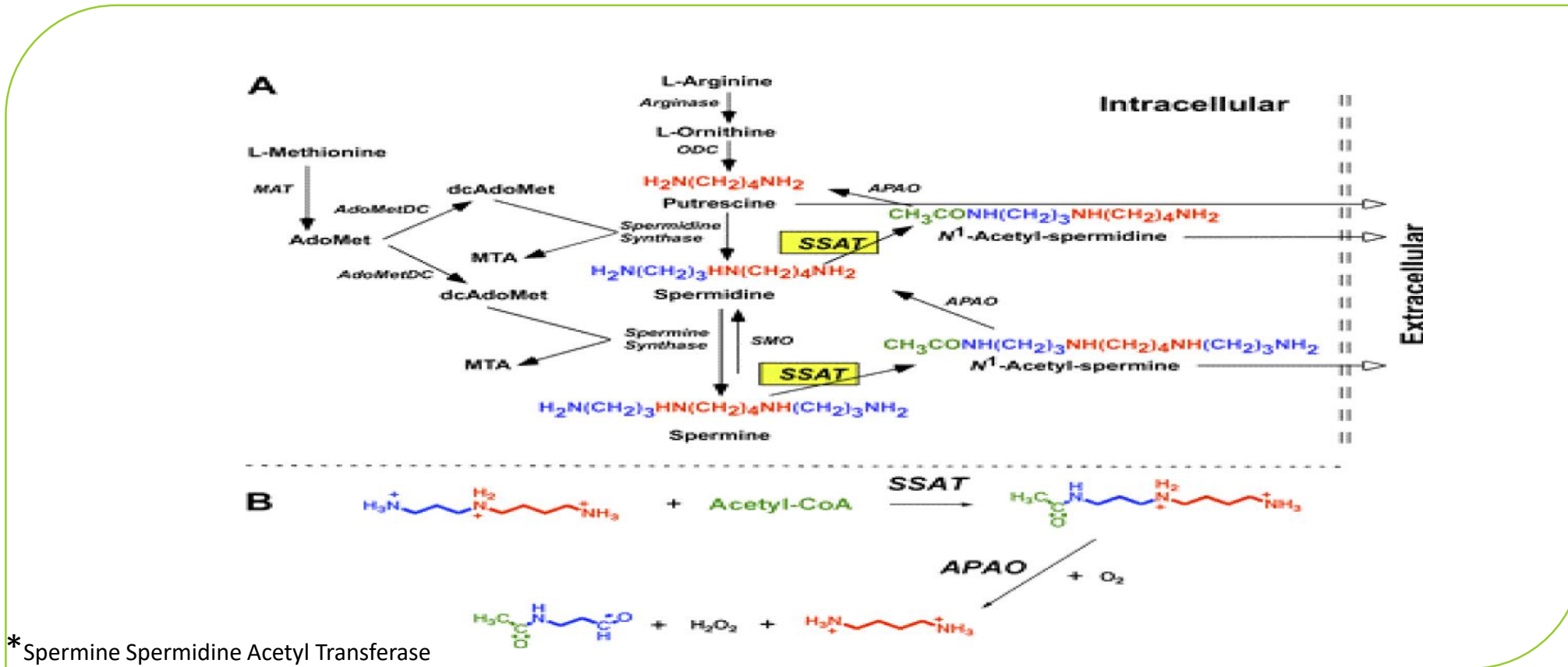
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# Assay I

## Acetyl Amantadine SSAT1 Assay



# SSAT1\* Biochemistry - Polyamine Pathway - Well Researched

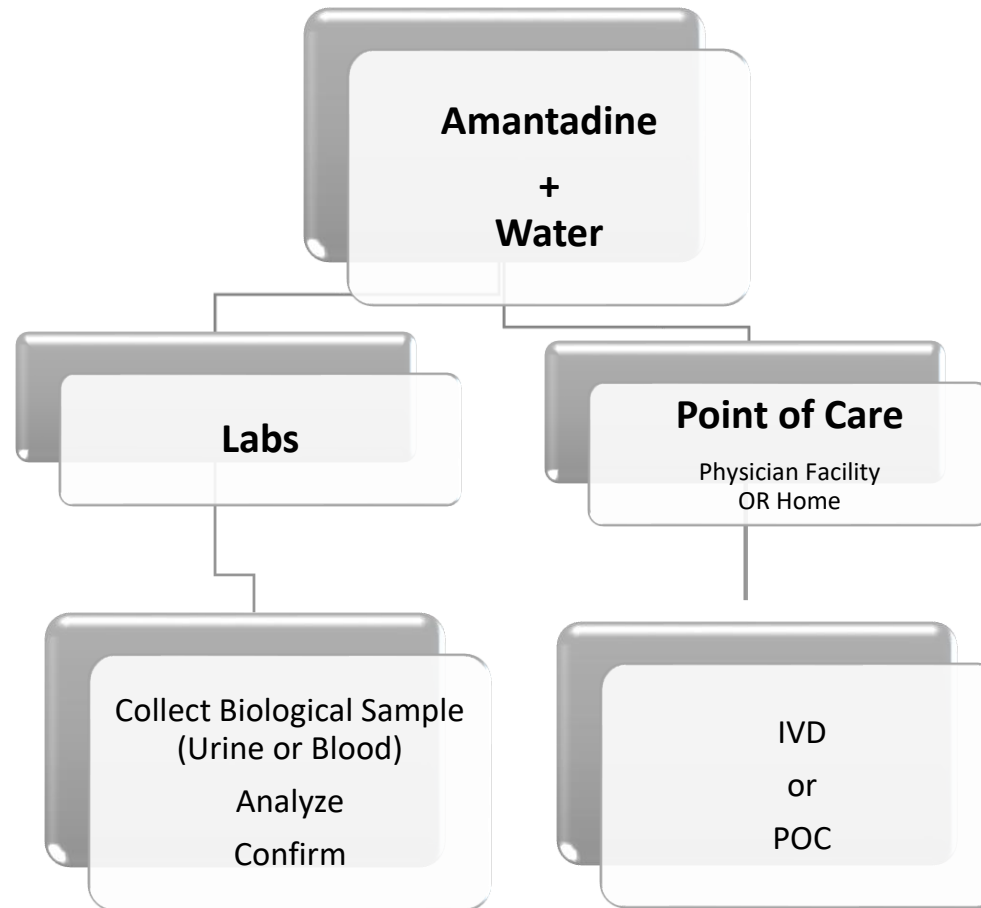
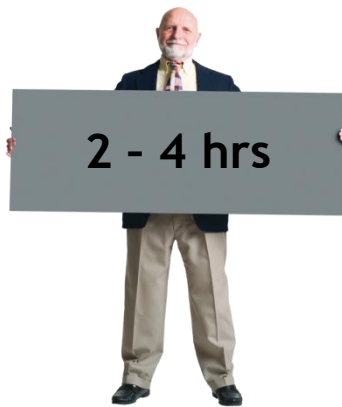


Source: American Journal of Physiology - Endocrinology and Metabolism Published 4 June 2008 Vol. 294 no. 6



# How We Conduct Our Test (SSAT1 Assay)

- Convenient & Non Invasive



# Activities undertaken in Discovery and Development Phase of SSAT1 Assay

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## Validation of SSAT1 platform / Expansion to other metabolites

- Confirmation at genomic level using PCR and cell line studies at BRI (2011-003)
- Proteomic level (Western Blot WB\*) – cancer tissue samples from Manitoba Tumour Bank and University of British Columbia
- Selection of cancers with highest gene expression for SSAT1 – Lung, Breast, Prostate and Glioblastoma Multiforme
- Identification of other new polyamine and select metabolites using Liquid Chromatography Mass Spectrometry (LC-MS)
- Increase specificity and selectivity by incorporating new metabolites and clinical parameters

\***Western Blot** (WB) is a common method to detect and analyze proteins.



# BioMark SSAT1 Assay - Measurement Technologies

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## Liquid Chromatography Mass Spectrometry(LC/MS) - Gold Standard

- Highly sensitive detection from urine and blood
- Secured Investigational and Testing Authorization from Health Canada 2014

## Modified Mass Spectrometry (DART) – Positioned to reduce quantification costs

## Point Of Care (ELISA Kit) - Prototype can be made in 6 months

- Generated monoclonal antibodies against small molecule
- Completed validation of these highly specific monoclonal antibodies
- Test to be completed on biological samples





# Current SSAT1 Assay Activities

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- **Phase III Clinical Trial** - Urinary Excretion of Acetylamantadine by Cancer Patients
  - Health Canada & Ethics Approval, in Canada & Bangladesh;
  - Completed clinical trial follow-up on outliers and preparing submission to Health Canada
- **Clinical Trial – Response to Chemo/Radio Therapy for Lung Cancer** - **Site:** Cancer Care Manitoba
  - Health Canada & Ethics Approval; Started patient recruitment. Several patients already completed studies. (PDL1 is semi quantitative and TMB(tumour mutation burden) variably correlates with response to treatment as per ASCO 2019

**Reference:** <https://asco-meetings.gallery.video/meeting-on-demand/detail/videos/sunday-highlights-of-the-day/video/6043750174001/lung-cancer%E2%80%94non-small-cell-local-regional-small-cell-other-thoracic-cancers?autoStart=true>

**\*SSAT 1 might be useful biomarker for personalization of neoadjuvant immunotherapy**

- **Clinical Trial – Response to Lung Cancer Resection** - Completed comprehensive protocol and in process to select a site and team to conduct trial
- **Use of SSAT1 for Glioblastoma** - the use of an SSAT1 based biomarker to assess surgical resection and determine potential physiological and anatomical correlation as a guide and complimentary tool to existing procedure



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## Assay II

# Targeted BioMarker Panel for Lung Cancer Using Serum



# Recently Completed Initiative - Discovery and Validation

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**Goal:** Discover and validate putative lung cancer on N. American cohort markers that :

- Distinguish normal vs lung cancer groups with emphasis on early stage 1 and 2 lung cancer.
- Separate the sub-types (adeno and squamous)
- Incorporate other clinical variables to assess impact on assay performance



# Targeted Metabolomics Lung Cancer Study

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## Data Summary

- **Metabolomics Analysis:** Human serum samples\* were analyzed using custom developed assay for several putative lung cancer biomarkers
- **Total subject: 257**
  - Normal: 60
  - Lung Cancer: 197 (emphasis on stage1 and 2)

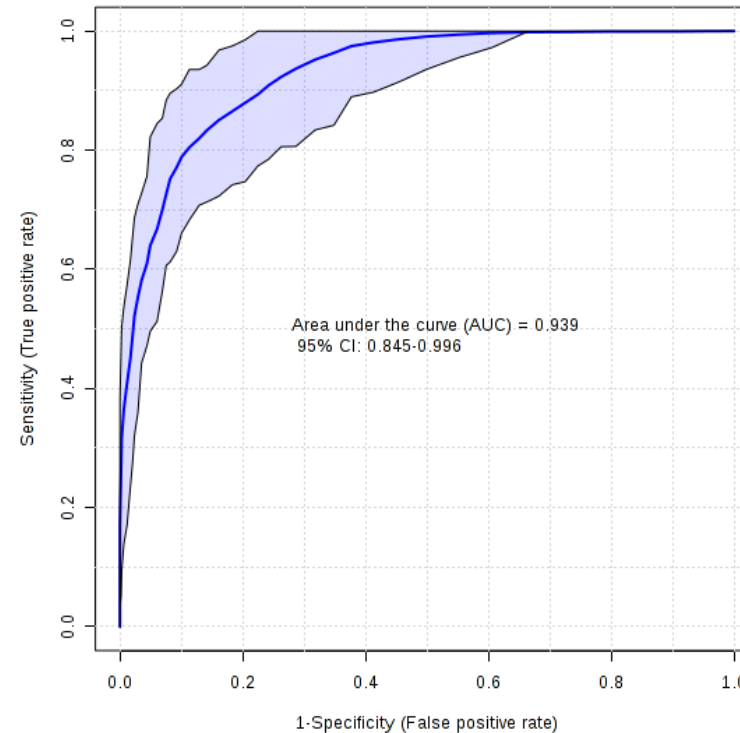
\* Samples and data obtained from IUCPQ



# Sample results - AUROC\*: Stage 1 vs Normal

**6 Metabolites  
included to  
the model**

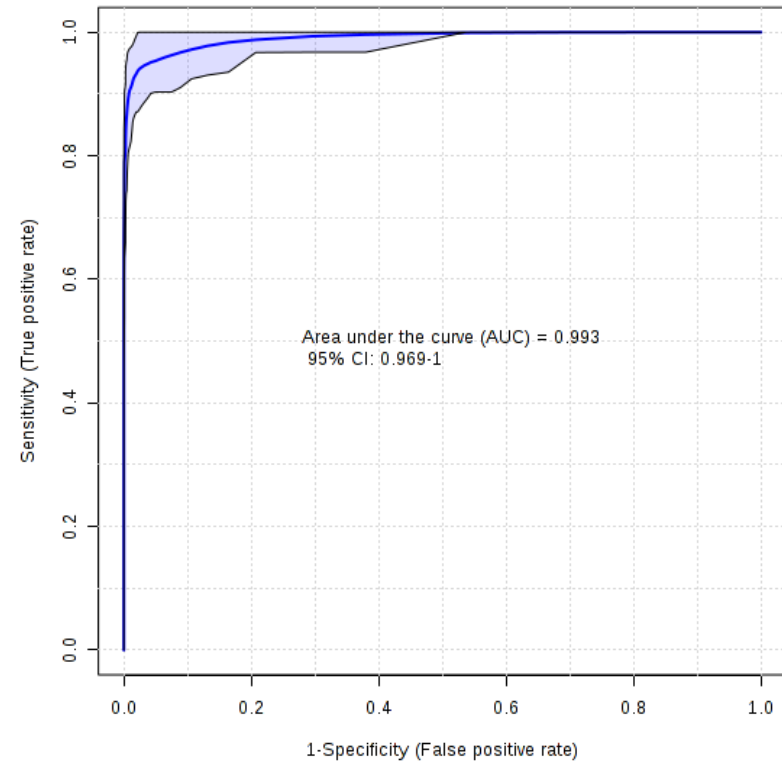
\*AUROC = Area Under Receiver Operating Curve  
AUC - ROC curve is a performance measurement for classification problem at various thresholds settings. Higher the AUC, better the model is at distinguishing between patients with disease and no disease.



# AUROC: Stage 1 vs Normal with Smoking

Stage 1 Vs Normal Model + Smoking  
(Period of smoking + Quantity of Smoking)

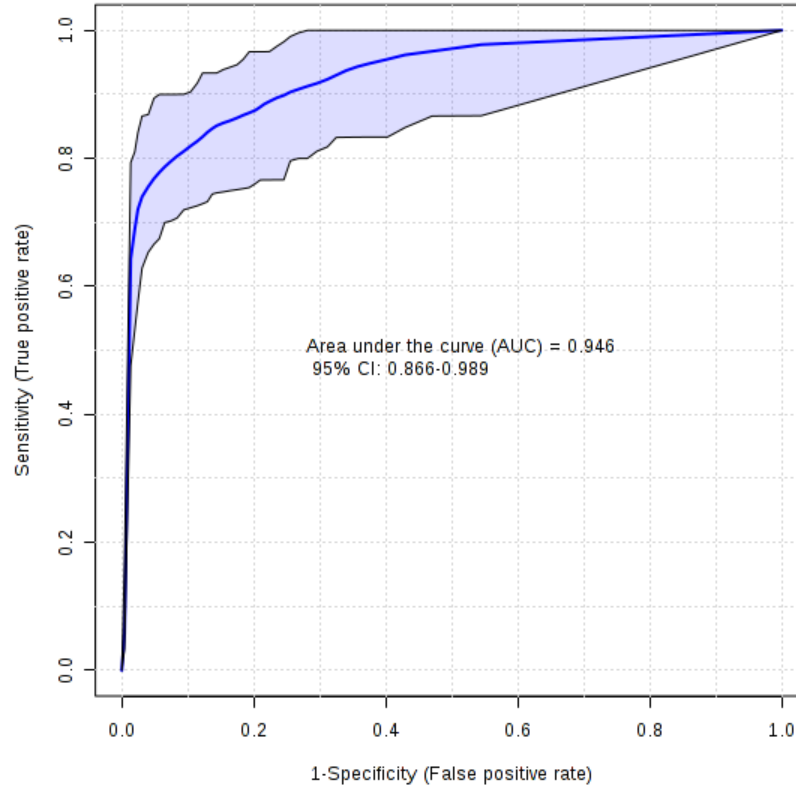
**6 Metabolites  
included to  
the model**





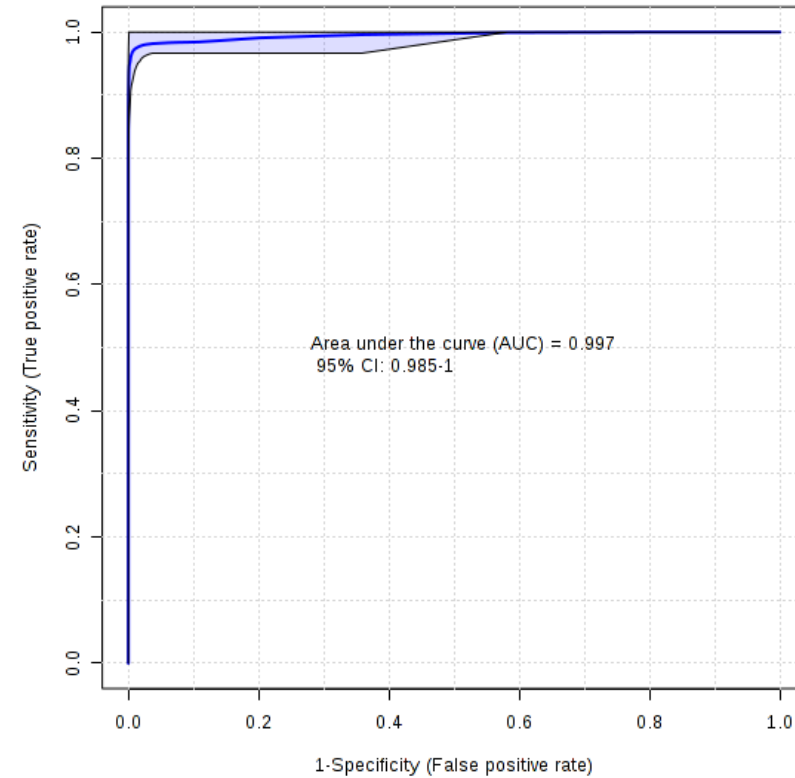
# AUROC: Stage 2 vs Normal

**5 Metabolites  
included to  
the model**



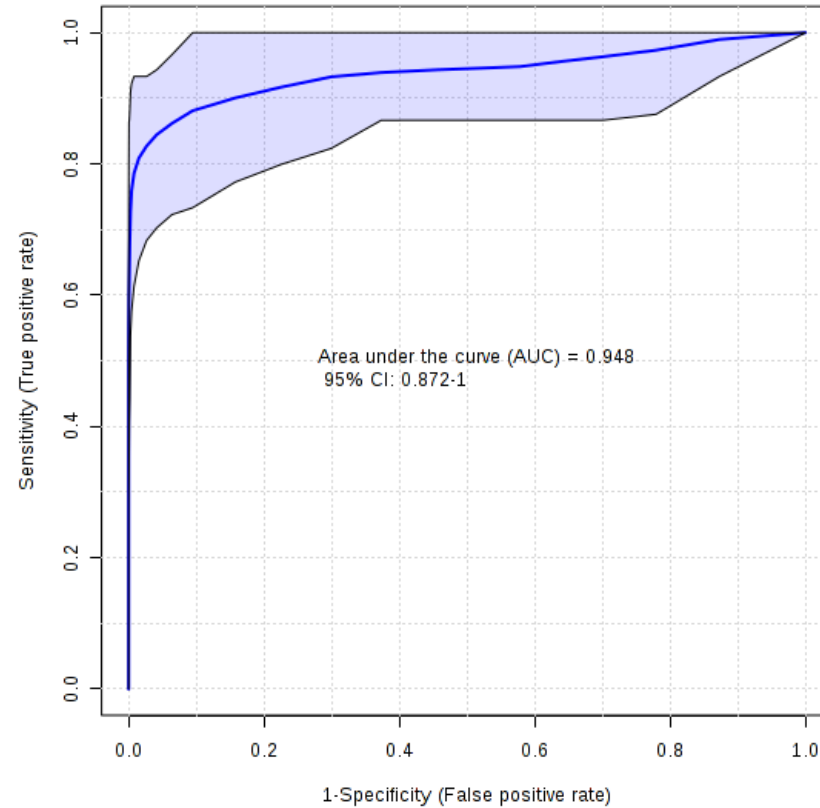
# AUROC: Stage 2 vs Normal With Smoking

**5 Metabolites  
included to  
the model**



# AUROC: Squamous (Stages 1 and 2) vs. Normal

**5 Metabolites  
included in the  
model**



# Next Steps for Lung Cancer Panel

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In progress -larger cohort studies based on power calculation (1200-1500)

- Various stages
- Sub-types
- Healthy and negative controls



# Multiple Clinical Applications of Lung Cancer Panel

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- Target the high-risk smokers on the Low Dose CT screening program in the US - Smokers over 55 in age with defined smoking parameters. Using 3 to 4 key metabolites plus other clinical variables can yield robust assay that can replace or complement the existing screening program.
- Early detection of lung cancer - staging difference between early stage(asymptomatic) and late stage
- Companion Diagnostic for drug development



# Lung Cancer Screening Program in US

## Results: Screening Sites and Performed LDCTs

U.S. Census Region	Estimated Eligible Smokers	2016			2017		
		Facilities	LDCTs	Rate	Facilities	LDCTs	Rate
Northeast	1,152,141	404	40,105	3.5	487	68,792	6.0
Midwest	2,020,045	497	38,931	1.9	672	73,490	3.6
South	3,072,095	663	47,966	1.6	905	88,649	2.9
West	1,368,694	232	14,080	1.0	293	24,912	1.8
<b>Total</b>	<b>7,612,975</b>	<b>1796</b>	<b>141,260</b>	<b>1.9</b>	<b>2357</b>	<b>256,088</b>	<b>3.4</b>





# Commercialization Roadmap -Market Focus: Lung Cancer

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## Lung Cancer High Risk Screening Program in USA

- Lung Cancer Screening in US for high risk groups to complement Helical CT Scan
- Estimated High Risk Population : 8 million
- Only 3.4% of the high risk population are screened using Helical CT; 18% cancers detected are indolent; over diagnosis
- Helical CT Scan – reduces mortality in high risk groups by 15-20%;

**Key Challenges** – Very high false positives; Exposure to radiation

### ➤Solution

- Use BioMark's assay which is cost effective and can potentially reduce false positive associated with Helical CT Scans.
- Follow patients with abnormalities that are too small or non-diagnostic on Helical CT scans



# Market Focus - Response To Treatment For Lung Cancer

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**Use BioMark's assay to predict response and outcome of systemic therapy for patients on chemotherapy and radiotherapy treatment**

## **Outcome:**

- Modify / Personalize treatment for patients earlier
- Reduce costs associated with expensive therapies with an annual cost estimated at about \$100K / patient
- Positively impact quality of life for patients



# Potential Revenue Streams

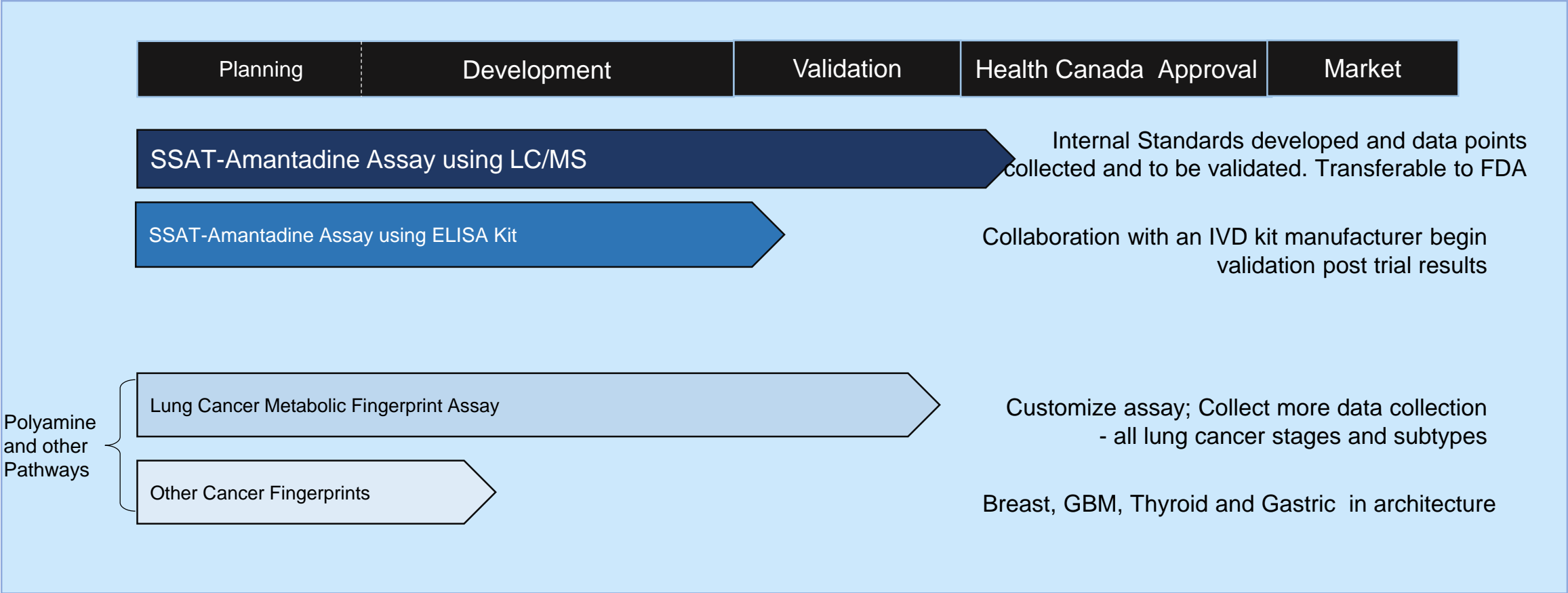
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- **Sales** of products / supplies
- **Royalty on** lab analysis (per test)
- **Licensing** – Territorial and distribution licensing
- **Services**
  - Monitoring
  - **Companion Diagnostics\*** (CDx) for drug companies

\*A companion diagnostic (CDx) is a diagnostic test used as a companion to a therapeutic drug to determine its applicability to a specific person.



# Technology Development Pipeline



# Traction

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***Regulatory*** - Secured Clinical Trial Acceptance and Investigational Testing Authorization (ITA) from Health Canada

***Innovation and Pipeline Expansion*** - Developed and validated specific fingerprints for lung and breast cancers with TMIC (The Metabolomics Innovation Centre)

***Integrating Analytics To Increase Predictive and Prognostic Capabilities*** - In process of developing software to accompany assays

***Recognized partners Local and Global Lab & Diagnostic Network - NDAs and MOUS***

***Near Revenue - Post Health Canada approval***

***International Collaborations*** - Completed discussions in Japan - Explore / Engage in potential co-development activities .Supported by Canadian Government



# Contact Details

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