



Real-Time Biosafety Air Exposure Monitoring using FLIR RapidPlex

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FLIR

ICx Technologies is now part of FLIR Systems, Inc.

FLIR Group	FLIR Business Group
Most FLIR groups (including FLIR Biosystems)	FLIR CBRNE Detection
FLIR Radar Systems	FLIR Surveillance
FLIR Tactical Platforms	FLIR Integrated Solutions

Chem-Bio Detection organization within FLIR CBRNE:

- Biosystems, La Jolla, CA
- Biodefense, Albuquerque, NM
- Enzymes Technology, Pittsburgh, PA

FLIR CBRNE offers array of sensor products

CHEMICAL



Griffin 450

Griffin X-Sorber

ChemSense 600

Agentase CAD-KIT

BIOLOGICAL

IBAC

AirSentinel

BioCapture

BioBadge

RADIOLOGICAL & NUCLEAR

IdentiFINDER

Raider

radHUNTER

STRIDE

EXPLOSIVES

Fido XT

Fido PaxPoint

Fido FastGate

Fido OnBoard

Biodetection Capabilities

- **Biodetection platforms**
- **Sampling**
- Sample preparation
- UHTS and bioinformatics
- Rare cell isolation
- Single cell analysis

Repurpose homeland security Biothreat detection capabilities for Biosafety

Real Time Air Exposure Monitoring of Infectious/Toxic agents

- Analogous to Lab worker radiation monitoring
- Currently no method for Real Time monitoring of airborne exposure to infectious or toxic agents
- Current practice: Implement BMBL best practices including:
 - BSCs
 - PPE
 - Vaccinations
 - Needle Stick log
 - Etc...



Laboratory Acquired Infections

- 2002-2004 survey of Clinical Lab directors: 33% of labs reported at least 1 LAI
- Most extensive survey 1976-78: 4079 LAI - 173 deaths
 - Of 10 most common LAI agents 8 are airborne risks

An Outbreak of *Brucella Melitensis* Infection by Airborne Transmission among Laboratory Workers

JAIME E. OLLÉ-GOIG AND JAUME CANELA-SOLER



Weekly / Vol. 60 / No. 7

Morbidity and Mortality Weekly Report

February 25, 2011

Fatal Laboratory-Acquired Infection with an Attenuated *Yersinia pestis* Strain — Chicago, Illinois, 2009



[CDC Home](#) | [Search](#) | [Health Topics A-Z](#)

MMWR

Weekly

June 23, 2000 / 49(24):532-5

her, a man aged 60
ellitus, was evaluated
aches, and cough of
physician suspected
fection and referred

Laboratory-Acquired Human Glanders --- Maryland, May 2000



[CDC Home](#) | [Search](#) | [Health Topics A-Z](#)

MMWR

Weekly

October 29, 2004 / 53(42):988-990

Laboratory Exposure to *Burkholderia pseudomallei* --- Los Angeles, California, 2003

On July 26, 2003, the Los Angeles County Department of Health Services (LACDHS) received a report that a local clinical laboratory had isolated from specimens *Burkholderia pseudomallei*, a category B biologic terrorism agent and the causative organism for melioidosis, which is endemic to certain tropical areas. Because laboratory workers had manipulated cultures of the organism. CDC was asked to assist in the subsequent investigation. This report summarizes the results of that investigation, which

What if you could monitor Exposure in RealTime?

- **RapidPlex system:**

- Bacterial / Viral / Fungal / Toxin IDENTIFIER
 - Fully automated
 - Cartridge based
 - 15-30 min operation time
 - Input:
 - Automated air trigger and air capture system can be fitted
- OR
- Any liquified sample (e.g. swab)

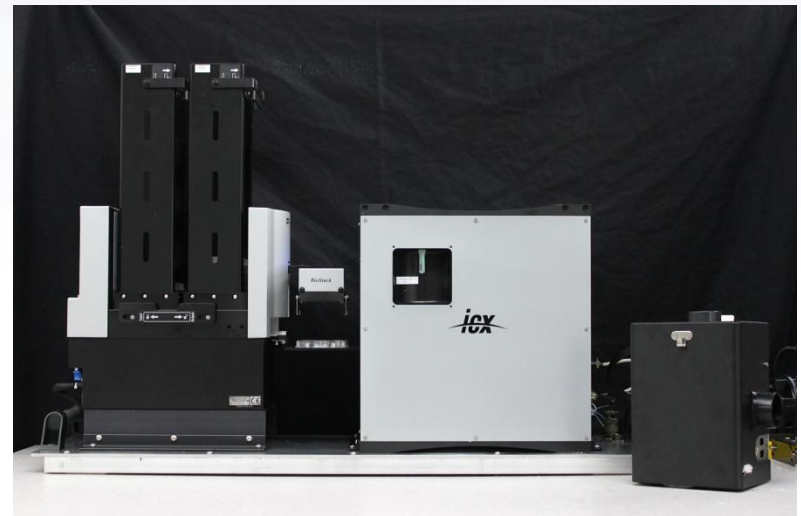


RapidPlex[®] | System Overview

- **Rapid biothreat detector developed under DHS Detect-to-Protect program**
- Fully automated biodetection platform
 - 10-30 minutes sample-to-answer times
 - **Simultaneous detection of 10-20 biothreats, including bacteria, viruses, and toxins**
 - **Unattended monitoring or point detection applications**
- Interfaces to various sampling modules for environmental testing and monitoring
 - **Air sampler**
 - **Water concentrator**
 - **Manual insertion of liquid sample**
 - Surface swab sample
 - Previously collected aerosol sample
- Applications:
 - Environmental monitoring
 - Building protection
 - Food/Water testing
 - **Lab worker Biosafety**
 - Clinical



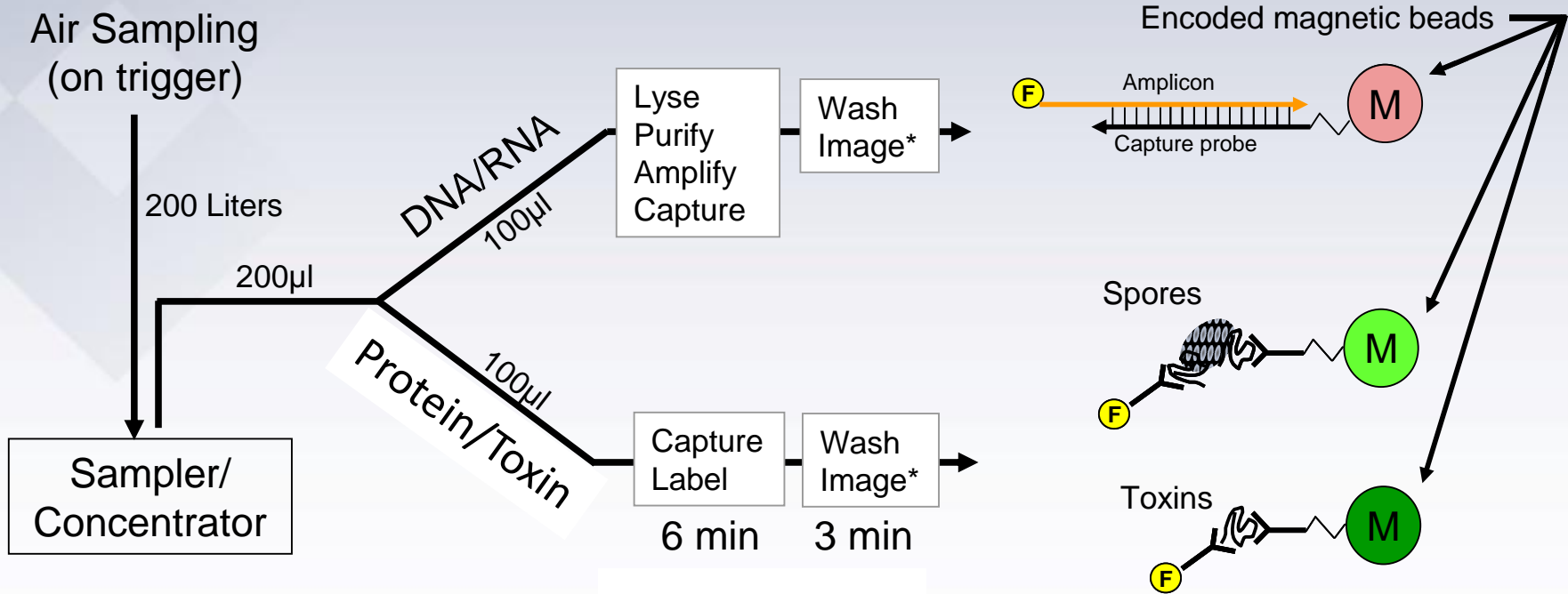
Standalone RapidPlex for point detection



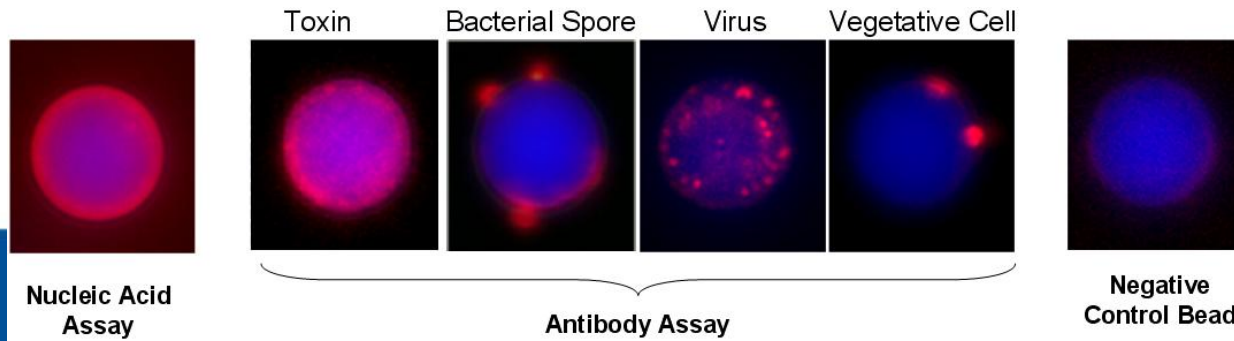
RapidPlex for unattended aerosol monitoring

RapidPlex Assay Technologies

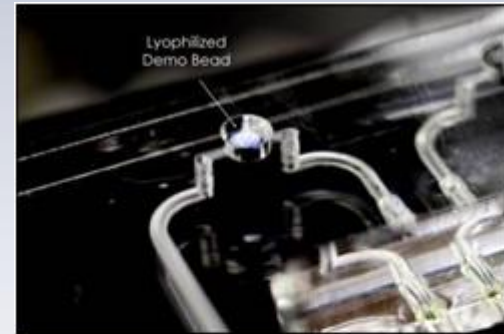
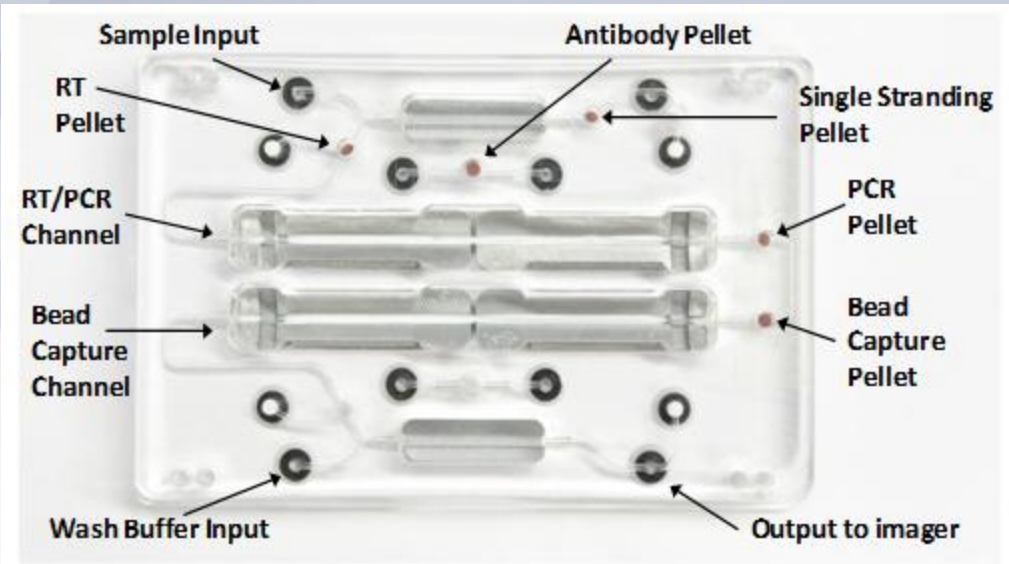
Nucleic Acid and Protein Detection



- DNA/RNA assays run in parallel with antibody assay (Protein/Toxin)
- Fluorescently encoded magnetic beads are imaged for detection readout



Consumable cartridges



Lyophilized pellets stored in-line with fluidics channels



Resuspend quickly (seconds) as sample flows through chamber

- **Consumable cartridge** contains all reagents necessary to run a single detection test (10-20 target ID)
- **Standard 96 well microplate** format allows use of off-the-shelf automation for autoloading cartridges during unattended operation
- Lyophilized reagents are **stable for >6 months** at temperatures up to 45 degrees C



Biotek Plate Stacker interfaces to RapidPlex for unattended operation

Integrated System: 3 modes of operation

FLIR BioLaz 504



Continuous
Monitoring Trigger
(IBAC)

FLIR BioXC 200i



Rapid
Air Sampler
(BioXC)

FLIR RapidPlex



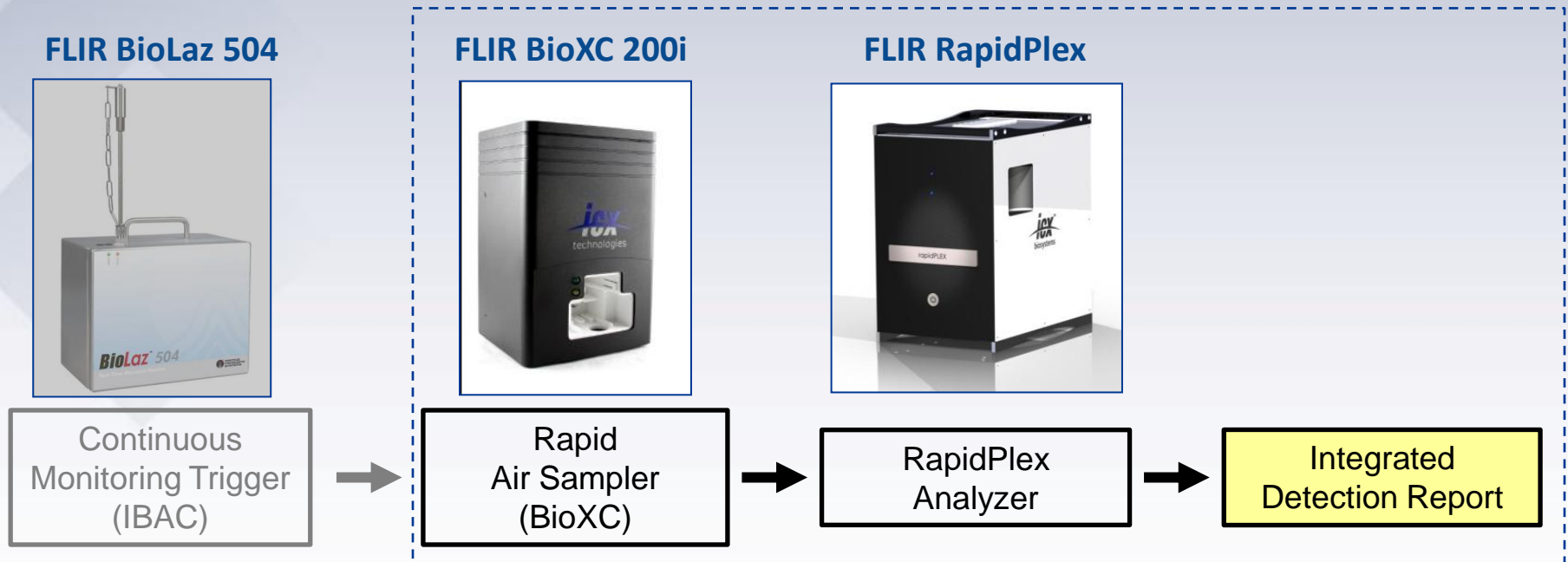
RapidPlex
Analyzer

Integrated
Detection Report

1. Real-Time sampling:

- Researcher loads Specific-Assay cartridge at start of experiment
- Air is continually monitored – Sensing of organic particles triggers Air sampler and RapidPlex analyzer

Integrated System: 3 modes of operation

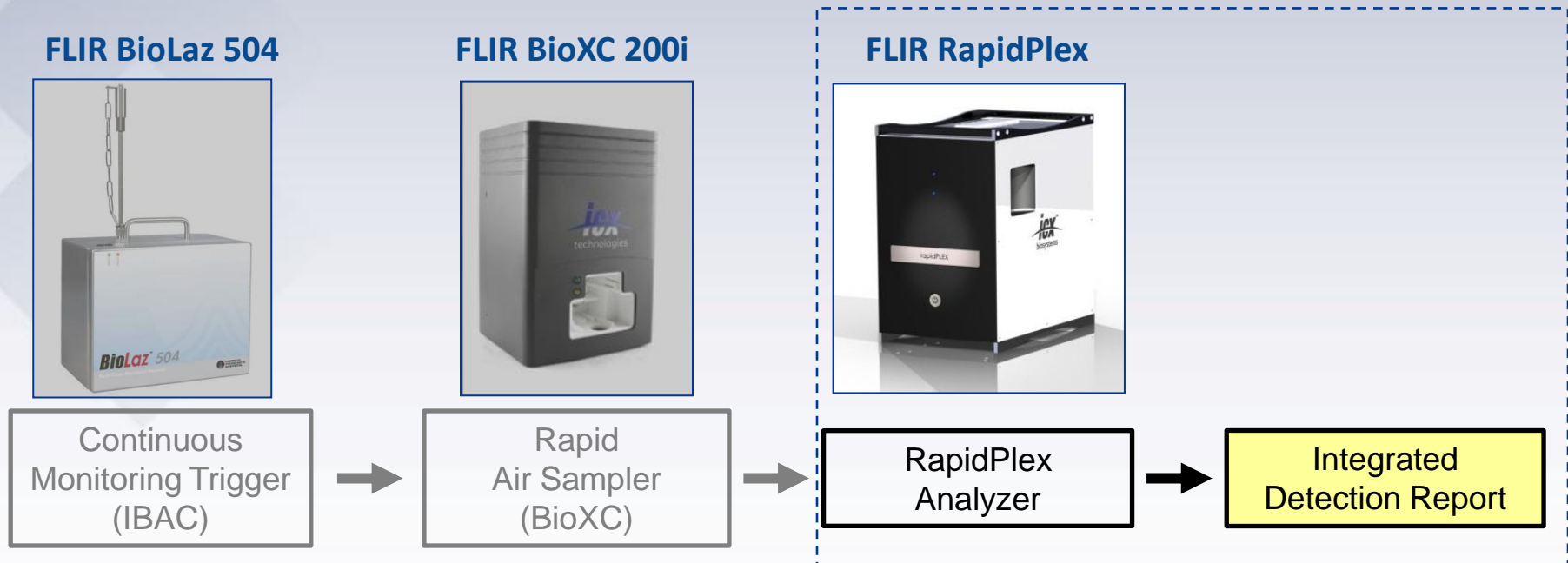


1. Real-Time sampling:

- Researcher loads Specific-Assay cartridge at start of experiment
- Air is continually monitored – Sensing of organic particles triggers Air sampler and RapidPlex analyzer

2. Continuous air sampling – Post Experiment: Continually capture air, analyze at end of experiment

Integrated System: 3 modes of operation



1. Real-Time Sampling mode:

- Researcher loads Specific-Assay cartridge at start of experiment
- Air is continually monitored – Sensing of organic particles triggers Air sampler and RapidPlex analyzer

2. Continuous air sampling – Post Experiment: Continually capture air, analyze at end of experiment

3. Post-Experiment containment sampling: Surface swab post-experiment, analyze on RapidPlex

RapidPlex Assay Technologies

Multiplex Assay Panels

Current Biodefense Panel: 10 threats, 3 surrogates

Threat Type	Target	PCR Assay Targets
Bacteria: Spores	<i>Bacillus anthracis</i>	3 Chromosome, pXO1, pXO2
	<i>Bacillus atrophaeus</i> (surrogate)	1 Chromosome
	<i>Bacillus subtilis</i> (surrogate)	3 Chromosome
Bacteria: Vegetative	<i>Yersinia pestis</i>	4 Chromosome, pCD1, pMT1, pPCP1
	<i>Burkholderia mallei</i>	3 Chromosome
	<i>Francisella tularensis</i>	2 Chromosome
	<i>Escherichia coli</i>	2 Chromosome
DNA Virus	Vaccinia virus	2 genomic
RNA Virus	Venezuelan Equine Encephalitis	2 genomic
	MS2 (surrogate)	1 genomic
Toxin	Botulinum Toxin A	N/A (antibody assay)
	Ricin	N/A (antibody assay)
	Staphylococcal enterotoxin B	N/A (antibody assay)

- Customizable target list for various applications
- Additional assays take approximately 6-8 weeks to develop and validate

Ongoing third-party evaluations

- Pacific Northwest National Lab: inclusivity/exclusivity testing

- RapidPlex system



- Pilot deployment of three systems in Metropolitan subway system

- BioXC / RapidPlex



- Pilot with classified customer

- Trigger / Air Sampler / RapidPlex



Third Party Blind Testing

- 45 blinded samples containing “threat” strains and “non-threat” near neighbor controls

Organism	Correct Identification
<i>Bacillus anthracis</i> (Anthrax)	13 of 13 strains
Non-threat <i>Bacillus</i> species	No Detect (13 strains)
<i>Yersinia pestis</i> (Plague)	10 of 10 strains
Non-threat <i>Yersinia</i> species	No Detect (1 strain)
<i>Francisella tularensis</i>	7 of 7 strains
Non-threat <i>Francisella</i> species	No Detect (1 strain)

Summary



RapidPlex for Biosafety Exposure Monitoring

- Laboratory/Occupational Exposure monitoring platform for identification of microbial pathogens and/or protein toxins
 - Containment verification: LAI, Genetically Modified Organisms
 - Risk Assessments
- Research Labs / Clinical Labs / Manufacturing
- Three modes of **Automated** operation:
 - **Real Time Sampling**: Organic particle sensing triggers automated air capture
 - **Continuous air capture** throughout entire experiment
 - **Surface swab** analysis
- Cartridge based: multi-assay format
- **We are seeking partners/collaborators for beta-testing in laboratory/industrial environments**

Acknowledgments





End of Presentation