Biodetection Technologies 2013: Technological Advances in Detection & Identification of Biological Threats - 21st International Conference

Description: BIODETECTION TECHNOLOGIES 2013 - the 21st conference in our Detection Technologies conference series - is an internationally recognized meeting for experts in detection & identification of biological threats and point-of-care analytical methods. This conference will review feedback from the end-users on biodefense and biomedical technologies and explore the cutting-edge in R&D and commercialization efforts in the field, including:

- Point-of-care/clinical applications for pathogen/virus/threat detection and identification
- Rapid/cost-effective/sensitive/selective/reliable detectors for low resource conditions
- Simple, easy-to-use devices for air-, water-, and food borne pathogens without PCR
- End-users, vendors, OEMs, and first-responders perspective and experience from deployed and near deployment stages
- Point-of-care assays for resource limited, lab and clinical settings; mobile labs
- Technological challenges for rapid/early/specific sensitive detection; multi-sensing
- Reagentless vs. reagent biodetection systems
- Use Raman, Mass spectroscopy, LIBS, TRPS and other spectral methods for robust biodetection
- Role of nanotechnology and system miniaturization; MEMS and bioMEMS
- Use of biochip technology; microfluidics
- Advances in microarray and sequencing technologies
- Bioinformatics and forensics for biodefense
- Reducing false positives vs. detector sensitivity
- Field-deployable devices: portability/compatibility/reliability/scalability
- Non-PCR vs. PCR based detection techniques
- Feedback from end-users; issues of sensitivity/testing/evaluation/validation

Contents:

Organizer's Welcome and Opening Remarks

DTRA/JSTO's 24 Month Diagnostic Challenge - Phase II
Bradley R. Ringeisen, PhD, Lead, 24 Month Diagnostics Challenge, Science & Technology Manager, Diagnostics and Disease Surveillance Division, Joint Science and Technology Office (JSTO), U.S. Defense Threat Reduction Agency (DTRA)
DTRA/JSTO will present a progress report on the 24 Month Diagnostic Challenge. Initial Phase I evaluation of 12 diagnostic technologies is complete, with 4 technologies selected to move forward into Phase II development and evaluation. The assay development includes pathogen targets for antigen detection of dengue, malaria, melioidosis and plague. Two technologies will move forward for a clinical demonstration in 2014.

Deep-Ultraviolet, Multi-Wavelength, Resonance-Raman Detection of Bacteria
Jacob Grun, PhD, Chief, Special Projects, Laser Plasma Branch, Naval Research Laboratory*
A study of bacterial resonance-Raman signatures at multiple wavelengths in the deep-ultraviolet (210nm to 260nm) is presented. Some of the bacteria are genetically similar to a degree greater than 97% as measured by the bacteria's 16S RNA sequences. Others are less genetically similar. The signatures are measured in the bacteria's rapid-growth log phase as well as in the stationary phase, when bacterial growth slows as nutrients are depleted and bacterial growth is balanced by death. Also, signatures of bacteria grown in poor, average, and rich media are measured. Our ability to identify the bacteria from these signatures will be discussed. This presentation is supported by DTRA and the NRL Base Program.
*In collaboration with: P.Kunapareddy, Research Support Instruments; and R.Lunsford, NRL

Novel Diagnostic Approaches: Some Recent Trends from Public Health England
Seshadri S. Vasan, MD, FRSPH, Senior Business Development Manager (Research & Innovation), Public Health England, United Kingdom
Public Health England (previously Health Protection Agency) has a diagnostic technologies programme based in Porton Down, which aims to develop and evaluate novel diagnostic approaches most suitable for Point-of-Care (PoC) applications – some of which are showcased in this talk. For instance, we look at overall
host genomic response to infection, which has identified a sub-set of markers (between 6 and 10 markers) which, when used together, form a 'signature' specific for a particular pathogen (e.g. TB), that may also indicate the outcome and duration of infection with the likely prognosis. We also use sera obtained from individuals either naturally infected or vaccinated (if appropriate) with a particular pathogen and then 'pan' peptide arrays with these antisera to identify highly immunogenic antigen markers which may be further evaluated in diagnostic assays. This approach has resulted in the identification of a range of peptide markers for Anthrax which are characteristic of early infection with this difficult to treat pathogen. For Anthrax and a number of key pathogens of interest, we are also developing an environmental diagnostic platform with thermostable Adenylate Kinase (tAK) as a reporter enzyme. The tAK enzyme is linked to a detection system and this enzyme catalyses a reaction which is coupled to Luminol. The light output from the enzyme is directly related to the amount of enzyme present and thus fully quantifiable. Proof of concept has been obtained for Anthrax spores, but the proprietary extraction technology is equally applicable to a range of other environmental and/or clinical matrices such as soil, water, faeces, manure, white powders and plaster samples. The tAK enzymes also have wider PoC detection applications because they can be chemically conjugated or expressed as recombinant fusion proteins with a variety of binding moieties to enable specific detection of viruses, toxins, antibodies or other analytes in rapid immunoassay formats – yielding 100-1000 fold increases in sensitivity compared to traditional enzyme conjugates. Public Health England is now looking to for licensees and co-development partners to accelerate applications and public health benefits in this important area.

Networking Refreshment Break, Exhibit/Poster Viewing

The LabTube Platform – Disposable Cartridges for Automated Processing of Biochemical Assays in Standard Laboratory Centrifuges
Arne Kloke, PhD, Lab-on-a-Chip Division, HSG-IMIT, Germany*
A laboratory centrifuge can be applied to automate biochemical assays for point-of-care diagnostics or sample preparation such as DNA or protein extraction. Key innovation is integration of liquid handling into a 50 ml centrifuge tube. This "LabTube" harbors three revolvers which are stepwise rotated against each other by a g-force operated ball pen mechanics. The first revolver sequentially releases pre-stored reagents into the second revolver which is equipped with a mixing chamber and a solid phase column. Fractions of processed liquids are collected by the third revolver. Automated LabTube based DNA-extractions showed comparable yields to manual reference extractions.

Multiplex Detection in Blood and Plasma with a Resequencing Microarray
Robert Duncan, PhD, Staff Scientist, Lab of Emerging Pathogens, FDA Center for Biologics Evaluation and Research, U.S. Food and Drug Administration
Detection of pathogens in blood is required for donor screening and diagnostics. To stay ahead of emerging agents and make the process more efficient and flexible we are evaluating multiplex testing strategies. We have tested the Blood Borne Pathogen Resequencing Pathogen Microarray developed in collaboration with TessArae, LLC. Data will be presented showing optimization and final testing with coded spiked specimens and the limits of detection in the multiplex assay.

Development of Treatment Guiding Multiplexed Molecular Diagnostics for Drug Resistant Burkholderia mallei and pseudomallei
R. Paul Schaudies, PhD, Chief Executive Officer, GenArraytion Inc., and COL Bret Purcell, Deputy Chief, Bacteriology Division, USAMRIID
Burkholderia mallei is a gram-negative bipolar aerobic bacterium causing the disease Glanders in humans. Burkholderia pseudomallei is the causative agent for melioidosis in animals and humans. USAMRIID and GenArraytion have teamed to develop a multiplexed molecular diagnostic to identify both species independently and to provide treatment guiding information of the individual isolates. USAMRIID has an extensive collection of both Burkholderia mallei and pseudomallei. Antibiotic resistance profiles for individual isolates will be determined at USAMRIID and the extracted DNA analyzed by GenArraytion to correlate genotypic signatures with both the organisms as well as the antibiotic resistance elements. Multiplexed assays will be developed on both the Luminex and ABI PCR based platforms. Both of these platforms have FDA approved molecular diagnostics which will facilitate the development of a FDA approved molecular diagnostic.

Luncheon Sponsored by the Knowledge Foundation Membership Program

SAFETY Act: Risk Management for Providers of Anti-Terrorism Technologies
Bruce Davidson, Director, Office of SAFETY Act Implementation, U.S. Department of Homeland Security
Science & Technology Directorate
The SAFETY Act may limit the legal liability of companies that manufacture or sell technologies and services that have anti-terrorism capabilities. The “Safety” in SAFETY Act stands for “Support Anti-Terrorism by Fostering Effective Technologies”. This law was enacted by Congress as a direct result of 9/11 and as part of the Homeland Security Act of 2002 (Title VII, Subtitle G). By capping liability, the law promotes the creation, deployment and use of anti-terrorism technologies. Its ultimate goal is to protect the homeland and save lives.

Sepsis, MRSA, VAP: Molecular Pathogen and Antibiotic Resistance Detection in a Single Tube Multiplex LATE-PCR Assay
Arthur H. Reis, Jr, PhD, Professor, Department of Biology, Brandeis University
LATE-PCR is a form of asymmetric PCR generating large amounts of single stranded DNA that can now be probed over a large temperature space using molecular beacon probes and our newly designed Lights-On/Lights-Off probes. Background introductions to each of the bacterial infections and complexities of antibiotic resistance will be presented. The MRSA multiplex assay detects and identifies each SCCmec type as well PVL toxin and vanA resistance, and discriminates versus coag negative staph. The Sepsis multiplex assay is constructed in two ways to detect over 20 bacterial and fungal species in a single tube by targeting individual genes or the 16S rRNA gene for bacteria and a specific gene for candida species using our Lights-On/ Lights-Off approach. The VAP multiplex assay is a quantitative endpoint LATE-PCR assay using combinations of the MRSA and Sepsis gene specific assays.

Modeling an Approach to Define Sensitivity of Viral Detection in Sample Matrices Relevant to Biopharmaceutical Manufacturing – Examples with Microarray Readout
Szi-Fei Feng, Associated Principal Scientist, Vaccine Analytical Development, Merck and Co., Inc.
Advances in viral detection technologies have the potential to increase the safety assurance of medicines produced in biological production systems. However, taking full advantage of these technological advances in the regulated testing environment will require establishing protocols for standardization and performance testing. The most essential performance characteristics of detection methods for these applications include sensitivity, breadth of detection, and consistency. We have evaluated an approach to establishing the suitability of nucleic-acid-based detection systems, and have demonstrated it using a novel microarray-based viral detection system. Our approach is based on selection of the relevant challenge viruses, their preparation and characterization, their application to a robust sample preparation workflow, and quantitation of recovery by an independent means. This approach helps us evaluate the suitability of the workflow for handling diverse sample matrices, and also suggests a means by which technology users, developers and regulators can standardize the evaluation of critical performance attributes of novel detection technologies.

Networking Refreshment Break, Exhibit/Poster Viewing

The Microfluidic Bioagent Autonomous Networked Detector (M-BAND) - Fully Integrated, Automated, and Networked Field Identification of Airborne Pathogens
Kimothy L. Smith, DVM, PhD, Chief Technology Advisor, Positive ID - Microfluidic Systems*
We describe a fully automated and autonomous air-borne biothreat detection system for biosurveillance applications. The system, including the nucleic-acid-based detection assay, was designed, built and shipped by Microfluidic Systems (MFS), a wholly owned subsidiary of PositiveID Corporation (PSID). Our findings demonstrate that the system and assay unequivocally identify pathogenic strains of Bacillus anthracis, Yersinia pestis, Francisella tularensis, Burkholderia mallei, and Burkholderia pseudomallei. In order to assess the assay’s ability to detect unknown samples, our team also challenged it against a series of blind samples provided by the Department of Homeland Security (DHS). These samples included natural occurring isolated strains, near-neighbor isolates, and environmental samples. Our results indicate that the multiplex assay was specific and produced no false positives when challenged with in house gDNA collections and DHS provided panels. Here we present another analytical tool for the rapid identification of nine Centers for Disease Control and Prevention category A and B biothreat organisms. *In collaboration with: M.Sanchez, L.Probst, E.Blazevic, B.Nakao

Enabling Tool for Lab-On-A-Chip Immunoassays: Development System for Pathogen Detection Devices
Claudia Gärtner, PhD, CEO, microfluidic ChipShop GmbH, Germany
The detection of biological pathogens on immunological and serological level is widely used. The transfer of this technology on lab-on-a-chip devices as detection tool for various kinds of pathogenic targets is of utmost interest, since this allows for a lab-independent analytical tool, to be used at the point of interest. In order to enable the quick development of such lab-on-a-chip platforms, to look at sensitivity, cross-reactivity etc. of such assays, a generic platform to establish immunological and serological assay modules has been created. In all application cases, the assays are based on immobilized probes located in microfluidic
channels. Therefore a microfluidic chip and the respective bread-board instrument were realized, containing a set of three individually addressable channels, not only for detection of the sample itself but also to have a set of references for a quantitative analysis. The technical approach as well as sample applications will be presented.

Exhibitor/Sponsor Showcase Presentations – I / Concluding Discussion

End of Day One

Day Two

Exhibit/Poster Viewing, Coffee and Pastries

Rapid, Sensitive and Specific of Bacillus anthracis: A Comparison of Field Deployable iiPCR Detection System, POCKIT, and Triplex qPCR Reference Assay on the Laboratory AB7500
Jessie Trujillo, DVM, PhD, Veterinary Microbiologist/ Assistant Professor, Center for Advanced Host Defenses, Immunobiotics and Translational Comparative Medicine VMPM, Iowa State University*

Rapid, sensitive and specific field detection of Bacillus anthracis is essential for timely initiation of mitigation measures and post-exposure prophylactics. We performed a laboratory comparison of a real-time polymerase chain reaction (qPCR) assay (Wielinga, et al 2011) on the AB7500 to a custom field deployable detection system; POCKIT (GeneReach) that utilizes insulated isothermal PCR (iiPCR). A three target strategy detecting one chromosomal target (PL3) and two plasmid targets (pXO2 and pXO1) was selected. Linear Limits of detection (LOD) were determined for qPCR on AB7500 and iiPCR on POCKIT. DNA from three Bacillus anthracis strains and two exclusivity species (B. cereus and B. thuringiensis) were used. qPCR LOD on the 7500 for B. anthracis is 2.5 to 25 genomic equivalents (GE/rxn for qPCR targets. LOD for B. anthracis on the POCKIT yielded equivalent sensitivity for PL3, pXO1, and pXO2. Exclusivity testing utilizing 25,000 GE/rxn demonstrated specificity for B. anthracis. This study provides significant equivalency data for rapid, sensitive and specific detection on a field deployable detection system, POCKIT for first responders, public health officials and veterinarians and a validated triplex qPCR assay on the Laboratory thermocycler for field result confirmation.

Point of Care Magnetorotation Assay for Ultra-Fast Drug Sensitivity Determination of Unidentified Bacteria
Raoul Kopelman, PhD, Professor of Chemistry, Physics, Applied Physics, Biophysics, Biomedical Engineering and Chemical Biology, The University of Michigan

Bacterial antibiotic resistance is one of the top concerns of modern healthcare worldwide, and the development of rapid growth based diagnostics is a key in addressing this problem. Faster diagnostic tests will reduce inappropriate antibiotic use, decrease health care costs, reduce the prevalence of antimicrobial resistance, and lower mortality rates. Here we introduce self-assembled AMBR biosensors for antibiotic susceptibility testing (AST), specifically in measuring the minimum inhibitory concentration (MIC) value, and demonstrate a prototype that can monitor multiple such biosensors simultaneously and measure bacterial growth within two hours. We rapidly measured the MIC for uropathogenic Escherichia coli isolate using the self-assembled AMBR biosensors. Reducing the time and cost required to determine the drug sensitivity of unidentified bacteria will have an important clinical impact, and may play a major role in pathogenic biodetection.

Novel Strategies for Point-Of-Care Diagnostics
Harshini Mukundan, PhD, Principal Investigator, Chemistry Division, Los Alamos National Laboratory

The talk will present recent work from LANL for the development of novel strategies for the rapid detection of pathogen biomarkers in patient samples with unprecedented sensitivity. This work resulted in the discovery of association of biomarkers with host lipoprotein carriers, a critical finding not only in the design of diagnostic assays, but also in our understanding of host immunity. In addition, we will also discuss new research from our team demonstrating the use of bacterial siderophores for the selective detection of only live bacteria in complex samples.

Networking Refreshment Break, Exhibit/Poster Viewing

Making it Small and Easy - Detection of Pathogens at the Point of Need
Frank F. Bier, Prof Dr, Dept Nanobiotechnology and Nanomedicine, Fraunhofer Institute for Biomedical Engineering IBMT, and Institute of Biochemistry and Biology, University of Potsdam, Germany*

Detection and indentification of pathogens is still cumbersome and time consuming. Thus, a broader use of point-of-care-testing is needed. This may be promoted in two ways: Firstly by integration of existing
technologies that are used in the laboratory into miniaturized and fully automated devices. The Fraunhofer ivD-platform is an advanced example of this type. Secondly, molecular integration of both recognition and signalling as currently being performed in our project „Lab in a Hankie“. Based on structures which are involved in the recognition of surface antigens by antibodies, novel molecular systems, the sensor-actor-molecules, are created to generate a visible signal triggered by contact with the pathogen. These systems may be integrated into devices for daily and easy use.

*In collaboration with: E.Ehrentreich-Förster, N.Gajovic-Eichelmann, S.Schumacher

From Viruses to Cells: Tuneable Resistive Pulse Sensors for High Resolution Nano-to-Micro Particle Characterization and Label-Free Biosensor Readout

Darby Kozak, PhD, Chief Scientist, Izon Science US Ltd*

Tuneable resistive pulse sensors (TRPS) have the ability to accurately characterize the size, charge and concentration of nano to micro-scale particles. Measuring the properties of each particle as it passes through the TRPS provides high resolution analysis often beyond that of other techniques. Furthermore, the ability to simultaneously measure size and charge on a particle-by-particle basis provides a unique method to characterize and understand the role that these properties play. We present the fundamental principles behind TRPS and demonstrate how it has been used to improve particle characterization and as a label-free biosensor readout.

*In collaboration with: W.Anderson, R.Vogel, U. Queensland (Australia); and M.F.Broom, Izon Science Ltd (New Zealand)

When is a Trace Detection “Significant“?

Steve Velsko, PhD, Senior Scientist and Associate Program Leader, Lawrence Livermore National Laboratory

We will discuss how to apply statistical significance testing to the detection of trace quantities of pathogen nucleic acids by PCR based techniques, and the utility of such tests in forensic investigations.

Lunch on Your Own

Electronic Solutions for Implementing, Tracking and Auditing EHS Programs

Patty Olinger, RBP, Director of Environmental, Health and Safety Office (EHSO), Emory University & Elizabeth R. Griffin Research Foundation

This talk will review tools readily available for EHS data gathering and management that did not exist 5 years ago. Whether you are in the field gathering data using an iPad, or reviewing a “cloud” dashboard, monitoring progress of program implementation, today’s technology can allow institutions to readily identify existing EHS program gaps. Allowing institutions to strategically focus resources where needed. While the examples discussed will focus on Biorisk Management the technology and methodology is applicable to any EHS discipline.

Biosurveillance System Enables Detecting Biohazardous Substances of Unknown Origin in Drinking Water

Sergei Makarov, PhD, CEO, AttaGene, Inc.

To detect the presence of biohazardous activities in drinking water, we use AttaGene’s proprietary reporter platform enabling simultaneous assessment of multiple signaling pathways within cells. By analyzing the pattern and amplitude of perturbations, induced by water sample in test cells, we can classify the hazardous substance and estimate the potential threat. A distinct advantage of our technology is that it affords detecting very broad range of biohazards of unknown origin.

Networking Refreshment Break, Exhibit/Poster Viewing

Molecular Recognition Elements in Sensing Applications

Letha J. Sooter, PhD, Assistant Professor, Dept of Basic Pharmaceutical Sciences, West Virginia University

Molecular Recognition Elements (MRE) are biomolecules with high affinity and specificity for a target. Of particular interest are single-stranded DNA (aptamer) and antibody fragment (scFv) MREs. Using conjugation chemistry these MREs may be incorporated into an array of sensing devices. MREs against pesticides and biowarfare agents have been isolated. Incorporation into optical sensing platforms has been achieved.

Laser-Induced Breakdown Spectroscopy as a Rapid, In-situ Clinical Diagnostic


Laser-Induced Breakdown Spectroscopy (LIBS) is an analytical technique in which light from a laser plasma is analyzed to provide information on sample identity and composition. Results analyses are available within seconds to minutes. Instruments can be operated with minimal training and be made portable. We have developed LIBS to detect bacteria, viruses, and parasites in the clinical matrices of human blood and cerebral spinal fluid. We will present results that demonstrate our analysis approach to the LIBS data
permits differentiation of inoculation type and concentration in clinical matrices for Staphylococcus aureus, Leishmania donovani, and Herpes simplex virus.

*In collaboration with: D.Cremers, ARA; R.Duncan, FDA; S.Young, TriCore Reference Labs

Deconstructing the Fear of Responding to a Biological Threat (title to be confirmed)
Christopher J. Cowen, Hazardous Materials Response Team, United States Capitol Police
Abstract is not available at time of publishing. Please visit www.KnowledgeFoundation.com for the latest Program updates.

Exhibitors and Sponsors Showcase Presentations – II / Selected Oral Poster Highlights

Concluding Remarks, End of Conference

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