US ARMY RDECOM

Biosurveillance in a Global Age: Harnessing the Expertise of the Broad Scientific Community

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

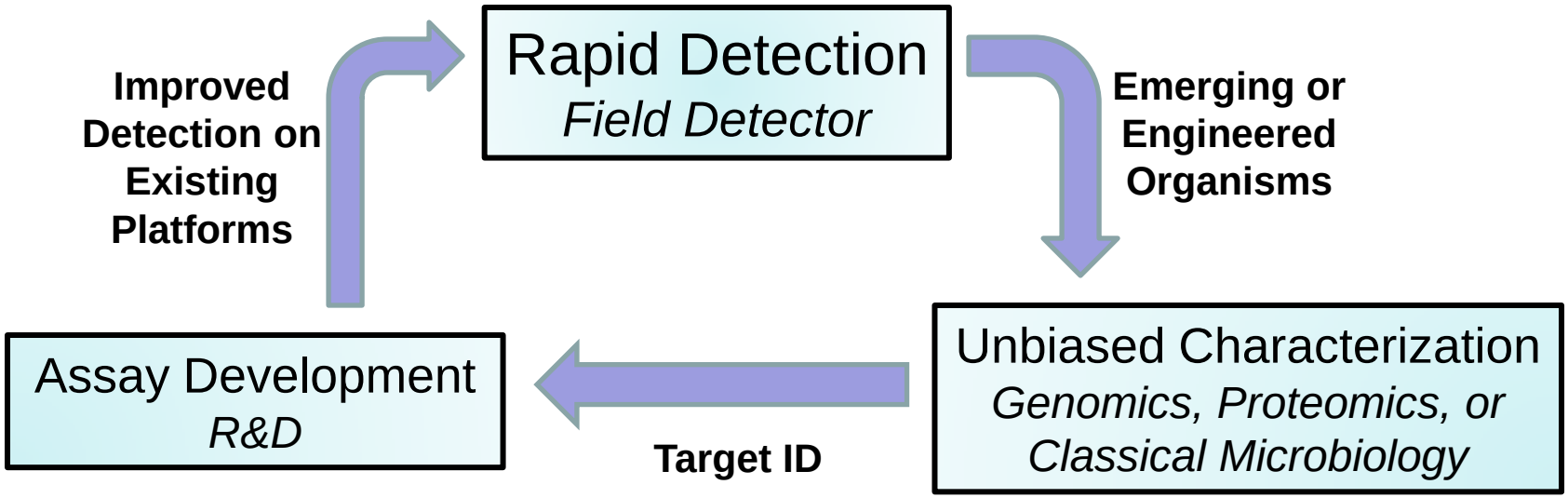
NDIA Biosurveillance Conference

Dr. C. Nicole Rosenzweig

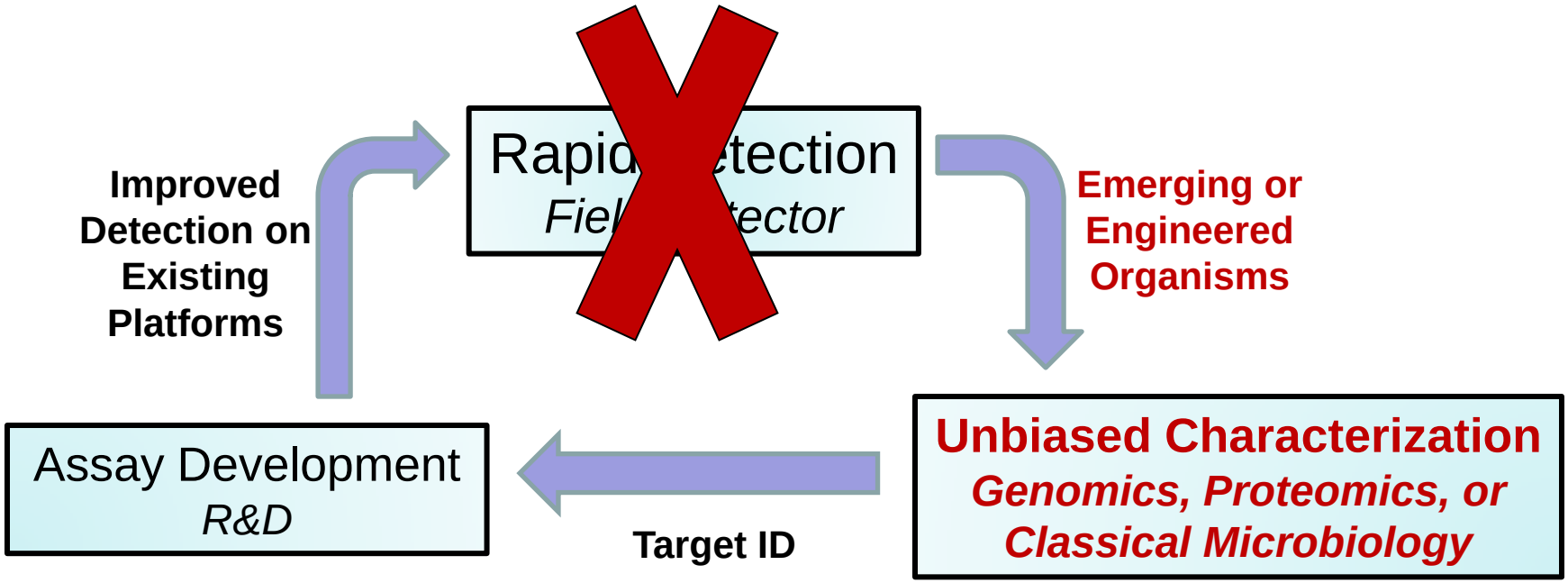
US Army, Edgewood Chemical Biological Center

27 August 2012

Analytical Gaps in Biological Detection



Analytical Gaps in Biological Detection



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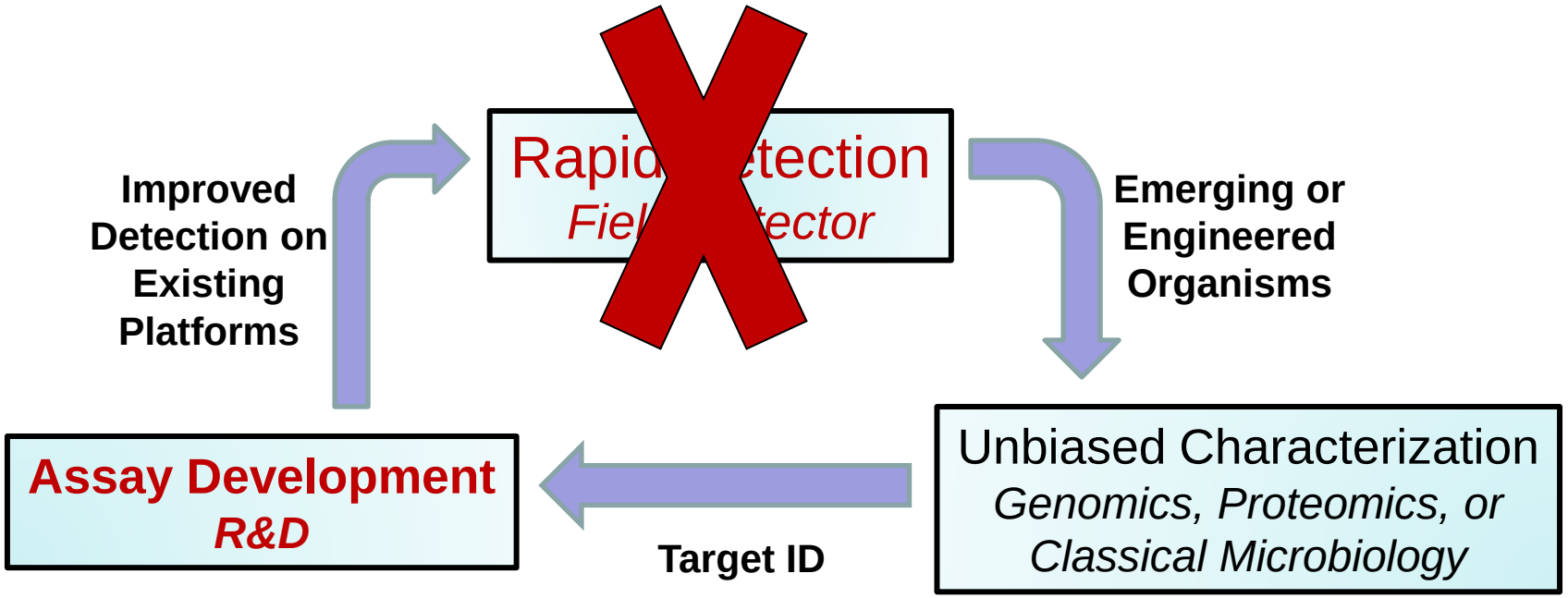
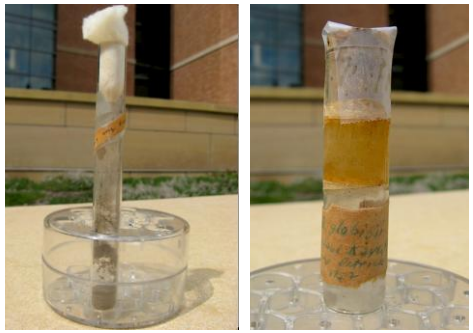


ECBC Genomic Sciences

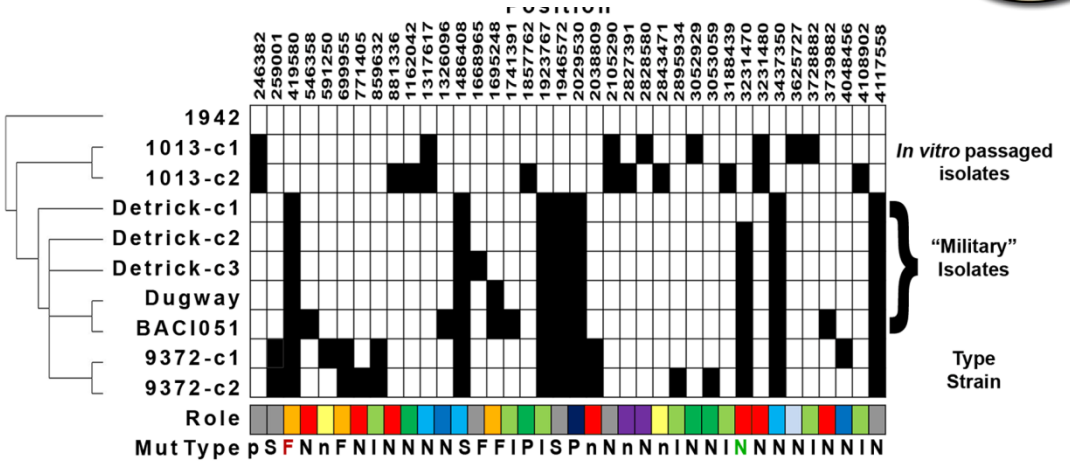
- Biosafety Level 3 laboratory for growing CDC category A and B select-agents
- Sequencing facility with the capacity to support of genomics and transcriptomics research
- BSL 2 and BSL 3 bio-aerosol research for challenging equipment and developing risk assessments
- Contemporary molecular biology, microbiology and biochemistry techniques
- Roche, Illumina, Opgen Argus platforms
- Sample processing experience with medical, environmental, and cultured material

Research Example: Microbial Forensics of a Historical Biowarfare Simulant

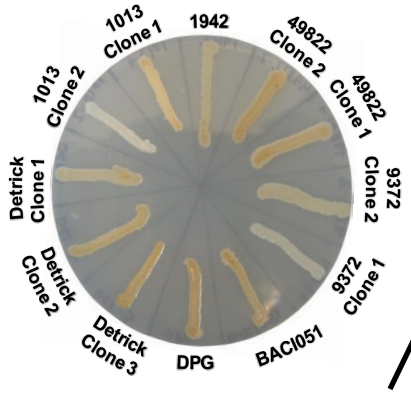
1942 Vogel | Detrick

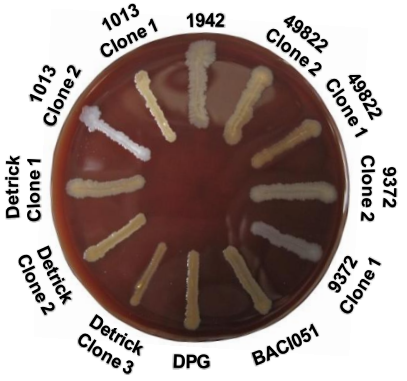


Whole-genome sequencing ID's Mutations

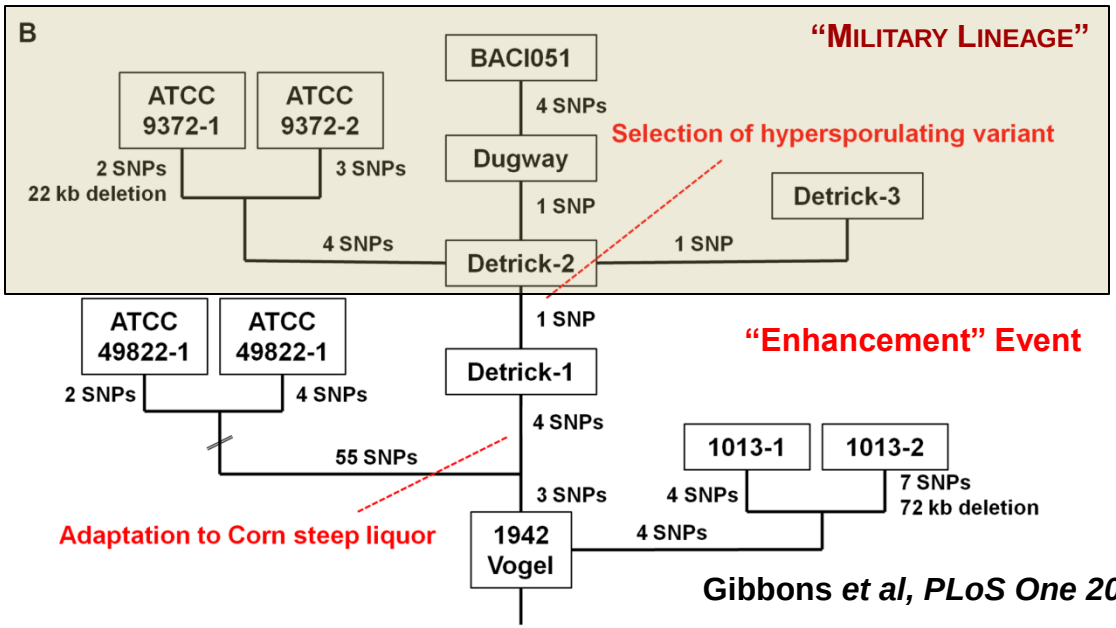


GENOMIC ANALYSIS





Strain Origins & History Revealed by WGS

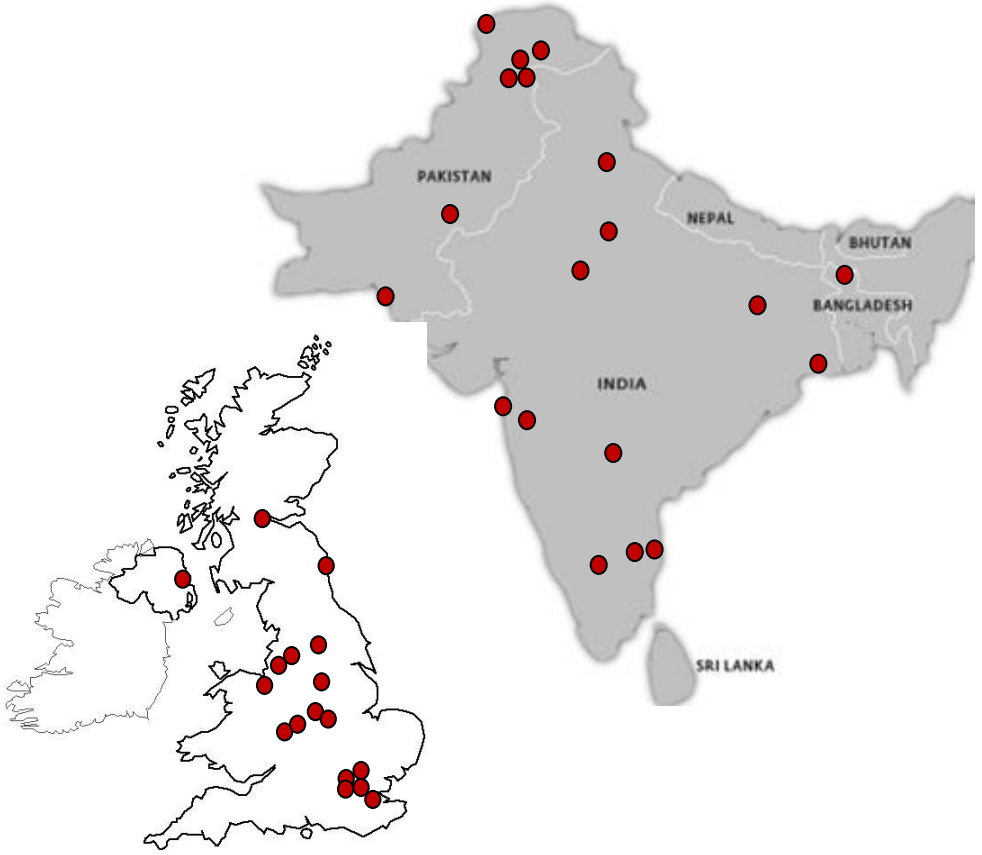


Gibbons *et al, PLoS One 2011*

Research Example: MDR Surveillance: NDM-1 *Klebsiella* and *E. coli*

MBL's are β-lactamase enzymes that can destroy virtually all β-lactam based Antibiotics Penicillins, cephalosporins and carbapenems

Antibiotic	MIC (mg/L)			% susceptible[a]
	Range	MIC_{50}	MIC_{90}	
Imipenem	8 - >128	32	128	0%
Imipenem + EDTA	0.125 - 8	0.25	1.2	n/a
Meropenem	2 - >32	32	32	3%
Ertapenem	2 - >16	16	16	0%
Ampicillin	>64	>64	>64	0%
Piperacillin	>64	>64	>64	0%
Piperacillin-tazobactam	32 - >64	>64	>64	0%
Cefotaxime	128 ->256	>256	>256	0%
Ceftazidime	64 - >256	>256	>256	0%
Cefpirome	>64	>64	>64	0%
Aztreonam	0.125 - >64	>64	>64	11%
Ciprofloxacin	0.125 - >8	>8	>8	8%
Gentamicin	0.5 - >32	>32	>32	3%
Tobramycin	8 - >32	>32	>32	0%
Amikacin	16 - >64	>64	>64	0%
Minocycline	2 - >32	16	>32	0%
Tigecycline	0.25 - 8	1	4	64%
Colistin	0.5 - >32	0.5	8	89%[b]

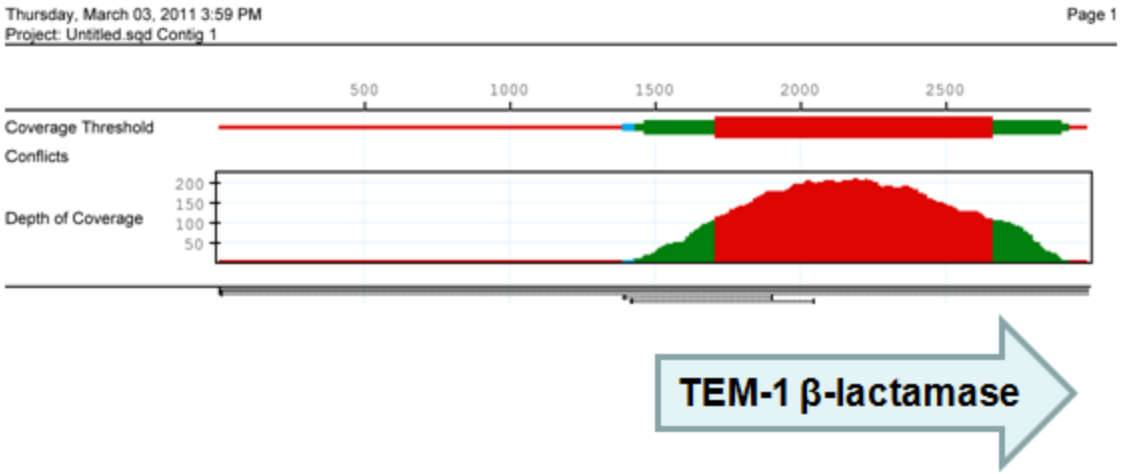


Mark Toleman, Cardiff University

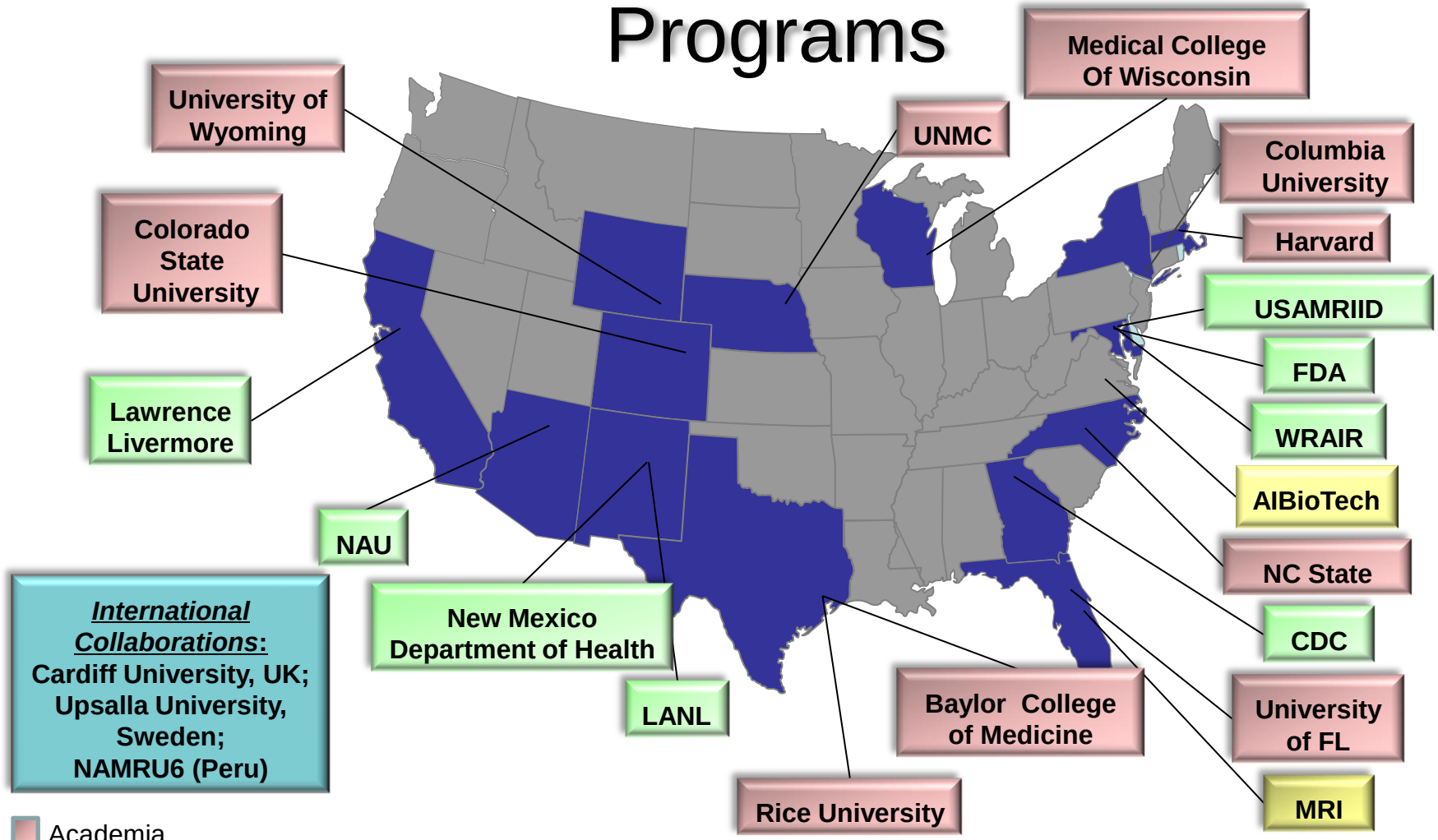
Research Example: Detection of Genetically Modification – *Yersinia pestis*

- Yersinia pestis KIM
- Constructed in 1990's in U.S.A. to facilitate pCD1 virulence plasmid transfer between strains
- Contains ampicillin resistance marker

Iteration	De novo contigs (Median Depth)	Total Assembled Bases	Identified Reference	RefSeq Accession	# Reads Mapped	% Ref coverage
1	205 (44)	4586247	YP KIM Chromosome	NC_004088.1	555517	98.64
2	14 (76)	169035	YP KIM pCD1	NC_004836.1	29312	95.92
3	6 (66)	104051	YP KIM pMT1	NC_004838.1	16076	95.43
4	2 (23)	8844	E. coli A2363 plasmid pAPEC-02-R	NC_006671.1	368	1.0
5	1 (22)	7616	YP KIM pPCP1	NC_004837.1	442	90.95



ECBC Is Involved in Active Biosurveillance Programs



System Integration

Long term: use best of breed analytics to improve analysis

Short term: identify capabilities that provide high-value analysis

2-Tiered System

Amazon Cloud

Web Services
Communication
Analysis Requests
Data Exchange

DoD Firewall

ECBC HPC

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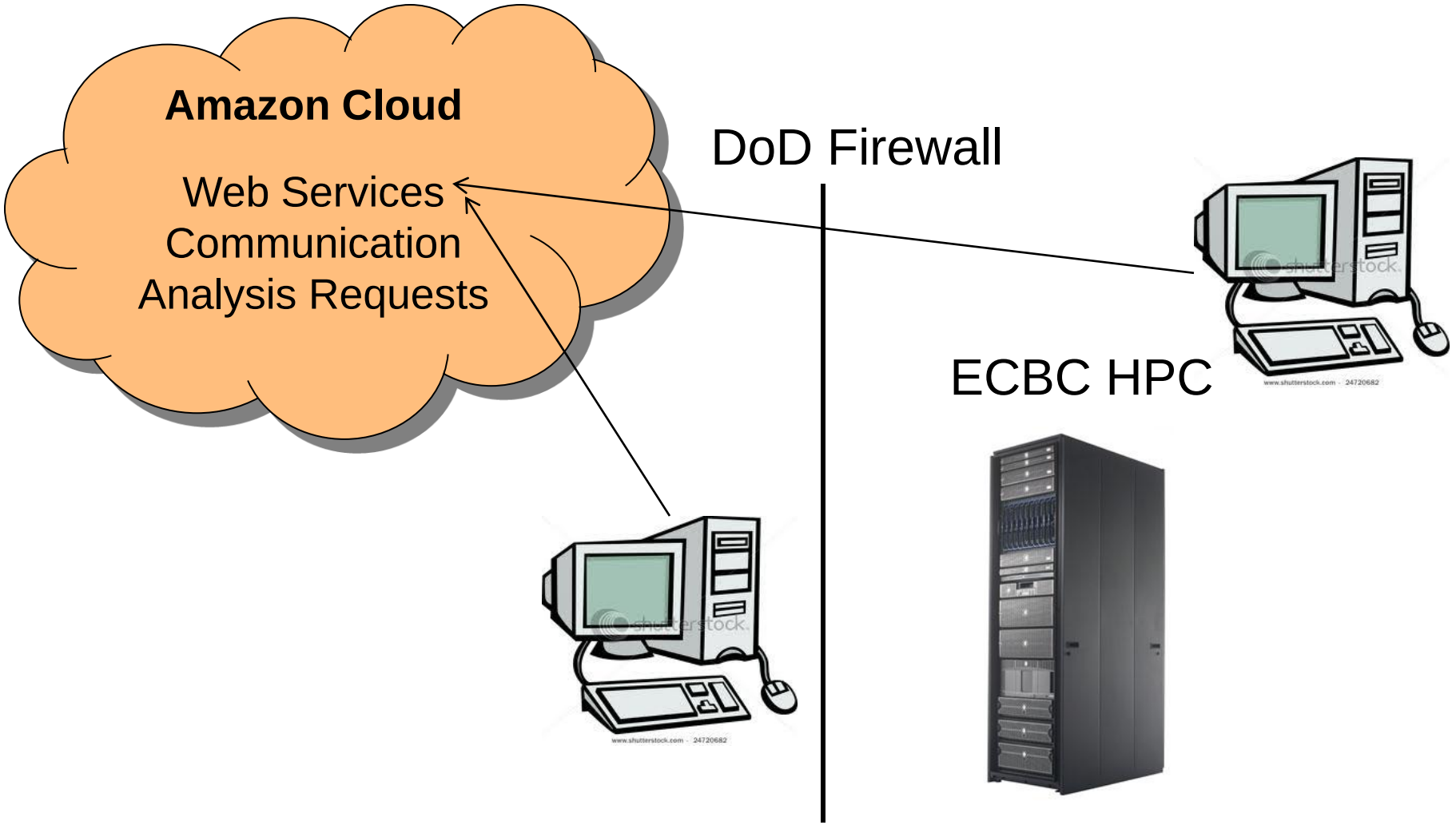

2-Tiered System

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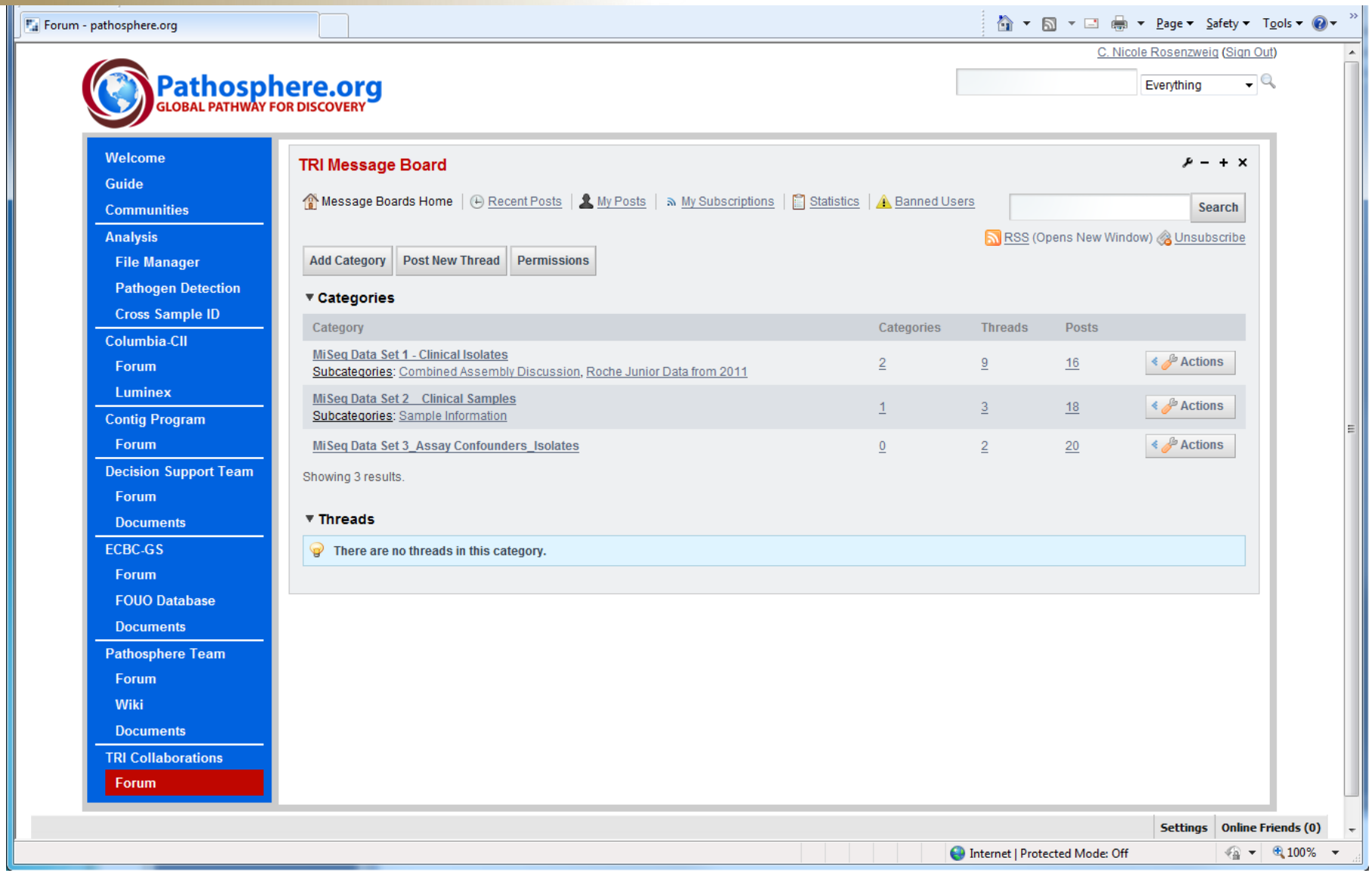
Pathosphere.org



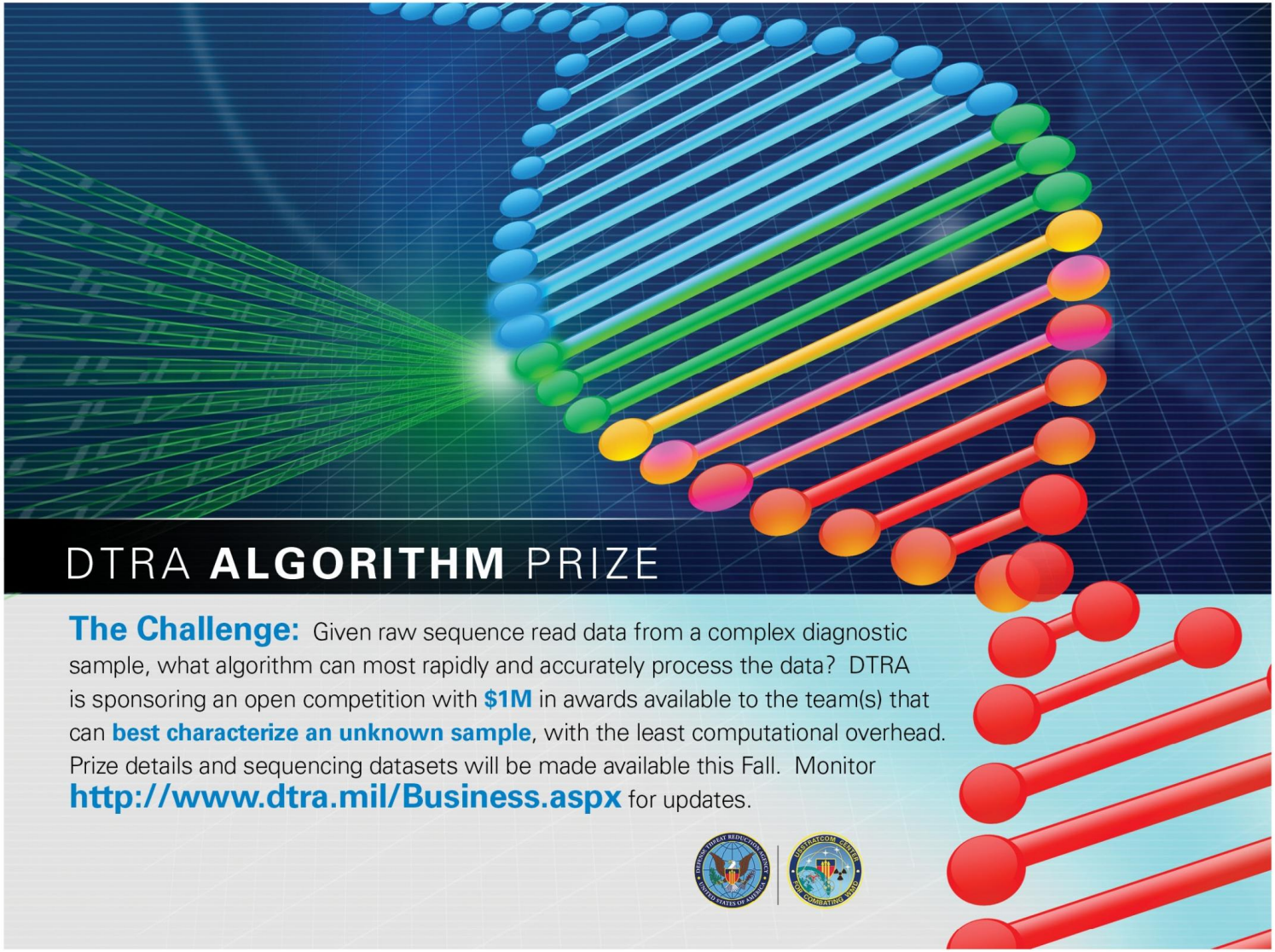
Biodetection for Biosurveillance

- Where do biodetection capabilities need improvement?
- How can research efforts support reliable biodetection for biosurveillance?
- How can analytical and data security be maintained while creating a flexible informatics capability?

What Now?

- Mechanism for DoD OCONUS facilities to share information between their personnel, regional hospitals, and US subject matter experts.
- Informatics resources should be developed in a way that provides a mechanism for analytical tool delivery in real time.
- Sequencing can be used for initial detection, but it is time consuming and expensive. Validation through traditional methods is required. Diagnosis completed by medical personnel.
- Decision makers make unambiguous decisions on ambiguous data. Scientific confidence must be communicated clearly.

Algorithm Prize



Contributors

ECBC

- Henry Gibbons
- Stacey Broomall
- Mohamed Aitichou
- Mark Karavis
- Joe Insalaco
- Alvin Liem
- Jessica Hill
- Michael Krepps
- Pierce Roth
- Eddie Salinas
- Ed Megan
- Greg Donarum
- Ed Fochler
- Patrick Carcel
- Josh Schulte

Columbia University

- Ian Lipkin
- David Hirschberg

TRI

- Evan Skowronski
- David Klinzing
- Kent Kawashima

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ECBC Mission and Vision

RESEARCH & TECHNOLOGY | ENGINEERING | OPERATIONS & INTEGRATION

WARFIGHTER NEEDS → WARFIGHTER SOLUTIONS





LIFECYCLE CHEMICAL AND BIOLOGICAL SOLUTIONS

MISSION: Integrate lifecycle science, engineering and operations solutions to counter CB threats to U.S. forces and the nation.

VISION: To be the premier resource for Chemical, Biological, radiological, nuclear and Explosive (CBRNE) solutions, uniting and informing the national defense community.

Basic research through technology development, engineering design, equipment evaluation, production support, sustainment, field operations and disposal.

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Technology Driven
Warfighter Focused

EDGEWOOD CHEMICAL BIOLOGICAL CENTER

For more information about the Edgewood Chemical Biological Center visit
www.ecbc.army.mil

or email the Public Affairs Office