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Novel Biosecurity Threats

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THANK YOU

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WHAT I WANT YOU TO KNOW

- Biosecurity is a unique subset of the security discipline
- Biosecurity has local and global implications
- Information gap is closing rapidly = Threats are growing rapidly
- Negligent researchers, malicious insiders, and curious do-gooders are equal threats
- Biosecurity is a field that needs codification and unification across science, security, public health, and health security

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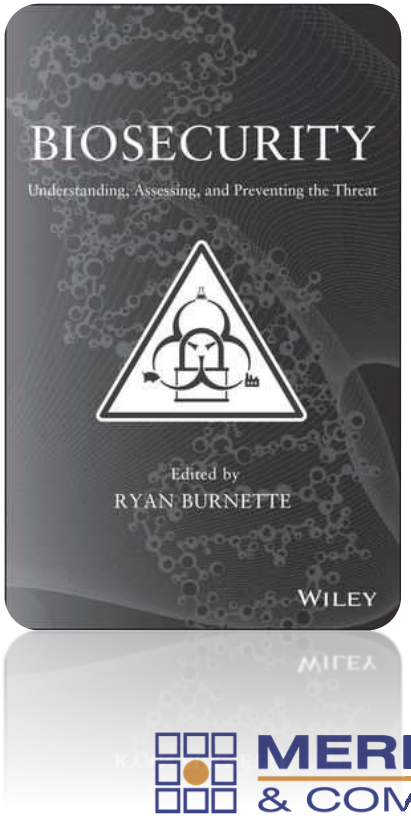
WHO AM I?

- Biochemist & Geneticist
- Biosafety and biosecurity practitioner
- Public health sympathizer



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TERMINOLOGY

- **Biosafety-** a set of practices and principles in the laboratory to mitigate exposure to infectious agents
- **Valuable Biological Materials (VBM)-** materials of biological origins (DNA, cells, biotherapeutics, etc.) that have financial value
- **Select Agents-** Biological agents (bacteria, viruses, fungi, toxins) that are regulated by USG

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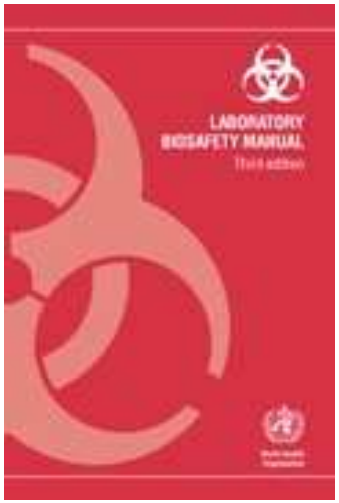
WHAT IS BIOSECURITY?

- Several definitions relating to 1) agriculture, 2) genetically modified organisms, and 3) infectious agents

"laboratory biosecurity…[as the] institutional and personal security measures designed to prevent the loss, theft, misuse, diversion, or intentional release of pathogens and toxins."

World Health Organization. Laboratory Biosafety Manual, 3rd Ed.



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PART ONE

- **The Science of Biological Risks, Threats, & History**
  - *How understanding the asset drives risk and threat management*

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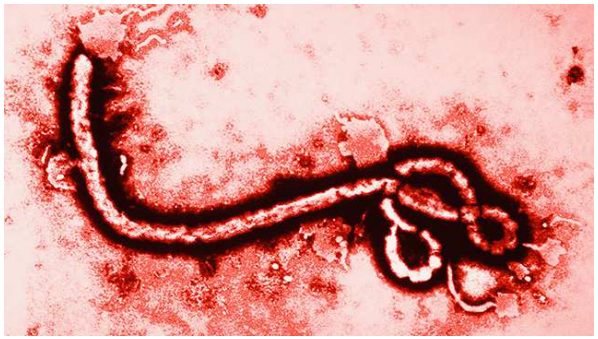
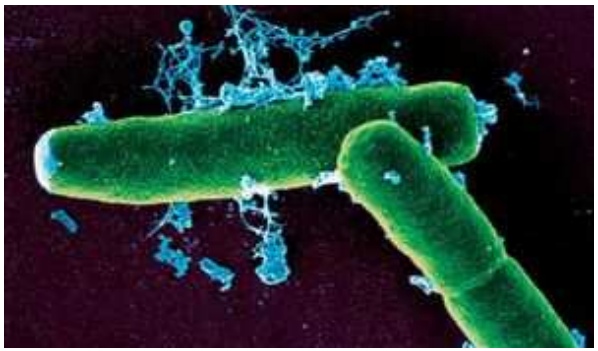
THE SCIENCE OF BIORISKS & THREATS



https://arstechnica.com/science/2014/11/understanding-the-ebola-virus/



https://microbewiki.kenyon.edu/index.php/Bacillus_Anthracis_NEU2011

- **Ebola virus disease (EVD)**
  - RNA virus (very sneaky)
  - Ingestion, subcutaneous, mucous membrane
  - No known cure

- ***Bacillus anthracis***
  - Spores last years, germinate upon host entry
  - Causative agent of Anthrax toxin
  - Inhaled, ingested, subcutaneous

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THE SCIENCE OF BIORISKS & THREATS

http://uasr.agropedias.iitk.ac.in/content/anthrax-disease-and-its-management-sheep-and-goat

http://www.foxnews.com/health/2016/11/03/ebola-adapted-to-target-humans-during-2014-outbreak-study-finds.html

- **Both EVD and Anthrax (and many others) are found in nature:**
  - Cannot secure the environment
  - Zoonotic (animal to human transmission)
  - Local outbreaks often unpredictable
  - The information gap is closing- no longer have to raid a lab
  - Can't be rapidly detected with mechanical devices or "sniffers" (some exceptions)

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BRIEF HISTORY OF BIOWEAPONS

- Ancient aboriginal people (South America) used darts laced with poisons from plants and animals.

- In 1346, Tartar forces catapulted plague-infected bodies into the Genoese trading post, Caffa. As the Genoese fled to Genoa/Europe, likely carried Y. pestis throughout Europe = “Black Death.”

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BRIEF HISTORY OF BIOWEAPONS

- 1763, Pontiac Rebellion, Native Americans dissatisfied with British, formed rebellion. British presented Delaware Indians with blankets contaminated with smallpox virus.

- 1865 - Dr. Luke Blackburn accused of attempting to weaponize yellow fever

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BIOSECURITY TODAY

- 2001 - U.S. Patriot Act - introduced mechanism for laboratory accountability
- 2002 - Public Health Security and Bioterrorism Preparedness and Response Act and Agricultural Bioterrorism Protection Act - introduced “security risk assessment”
- 2015 - White House releases “Memorandum on Biosafety and Biosecurity Measures”
- ***But what effect does this have on surveillance, outbreak response, and the common laboratory?***

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IN THE LABORATORY

Research, Hospitals, Clinical, Diagnostic, Public Health Labs:

- Maintain countless samples of infectious agents
- Most have developing (or robust) biosafety programs
- Most have fundamental security programs
- ***So why all the concern?***

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BIOSECURITY IS UNIQUE

- Assets (biological materials) are microscopic- difficult to detect
- They reproduce under the right conditions- only need to remove a miniscule amount
- Protection so far has been the knowledge necessary to work with them...

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PART TWO

- **Infectious Agents are Old but Things Are Changing**
  - *What is occurring that makes biologicals a growing concern*

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WHAT'S CHANGING?

- Information gap is closing
- Access is increasing
- Developing technologies are an unknown
- Climate change
- Lack of policy
- Organized threats
- Drug resistance
- Depleted antibiotic platform
- Emerging infectious disease

http://www.bugssonline.org/

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AND THE WORLD HAS CHANGED

"It's very hard to rate the probability of bioterrorism but the potential damage is very huge," Gates said during a panel at the World Economic Forum in Davos, Switzerland.

http://www.cnbc.com/2017/01/19/bill-gates-bioterrorism-damage-could-be-very-huge.html

- Terrorism
- Industry Competition
- Insider Threats
- Negligence
- QA/QC

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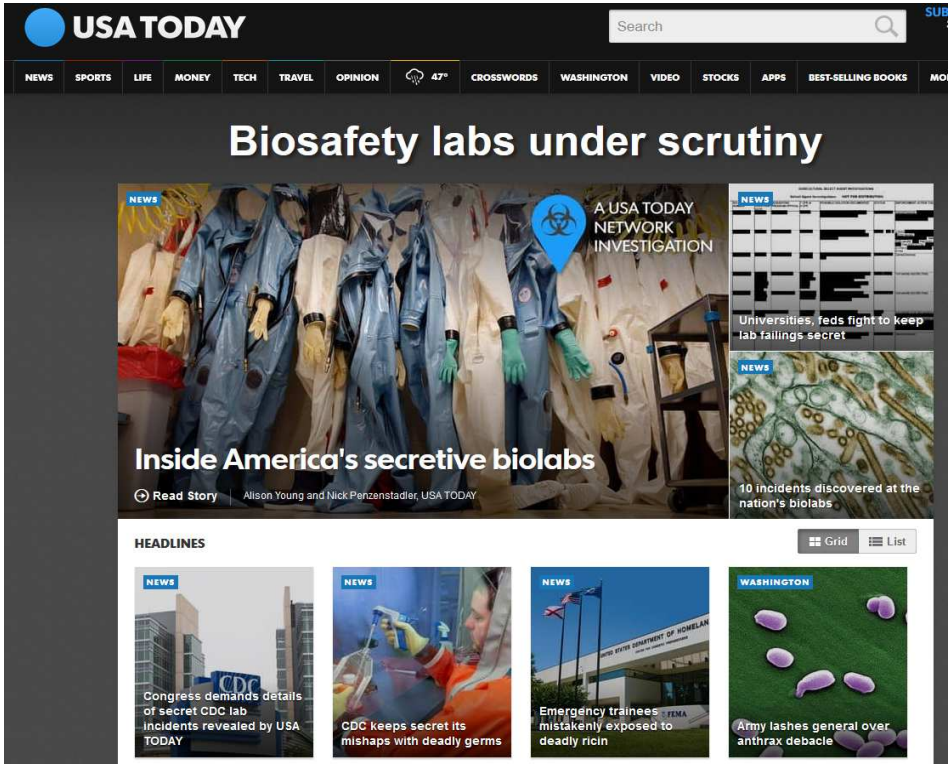
THERE WILL BE WINNERS AND LOSERS



http://www.usatoday.com/topic/9ee9e5de-b702-4fbc-9e5d-1b595adcf938/biolabs/

- Losers are not always in the wrong
- Mass casualty via disease not the only outcome
- Reputational risk

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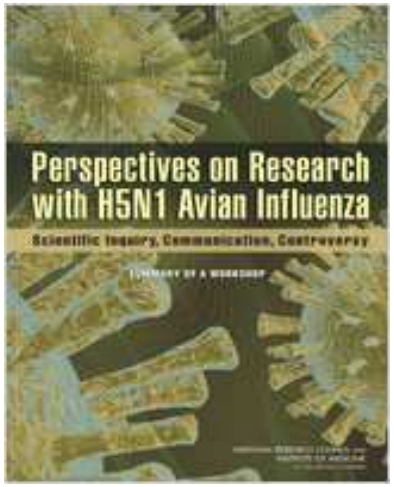
THE INFORMATION GAP IS CLOSING

- Like IT, biological sciences are becoming more accessible and "friendly"
- What used to require a Ph.D. can be found through open channels



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ACCESS IS INCREASING

- Community Labs are on the rise
- Equipment and reagents can be ordered online

Membership

Join Our Community of Biohackers

Monthly membership unlocks:

BSL1 lab, co-working space and shared equipment
Class and event discounts
Storage space in lab fridge, chemical cabinet and freezer
Free safety training & orientation
Office space with appointment

LEARN MORE

Biocurious.org

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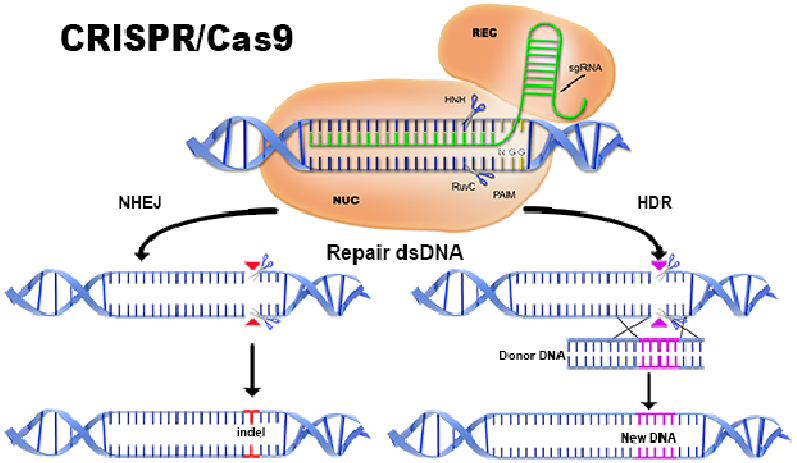
TECHNOLOGY IS ADVANCING

- Gene editing, gene synthesis, synthetic biology = new tools
- Virtually no regulations (think “smallpox”)



https://www.aati-us.com/instruments/fragment-analyzer/crispr/

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ORGANIZED THREATS ARE MOBILIZING

The Telegraph

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Islamic State seeks to use bubonic plague as a weapon of war

Islamic State research into biological and chemical weapons uncovered on seized laptop to target shopping centres and air-conditioning systems

- Terrorist groups known to invest in bioweapons research and production
- Taken together (shrinking information gap, greater access, outbreak hotspots, new technology) this is a huge concern

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OTHER CHALLENGES

- Climate change is creating new “zones” for emerging disease
- Virtually no regulations outside of BWC
- Global infrastructure to respond is low
- And new infectious agents continue to be discovered
- ***Is the point coming through?***

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PART THREE

- **Threats to the Lab and the Outbreak**
  - *Why threat management needs to learn biology*

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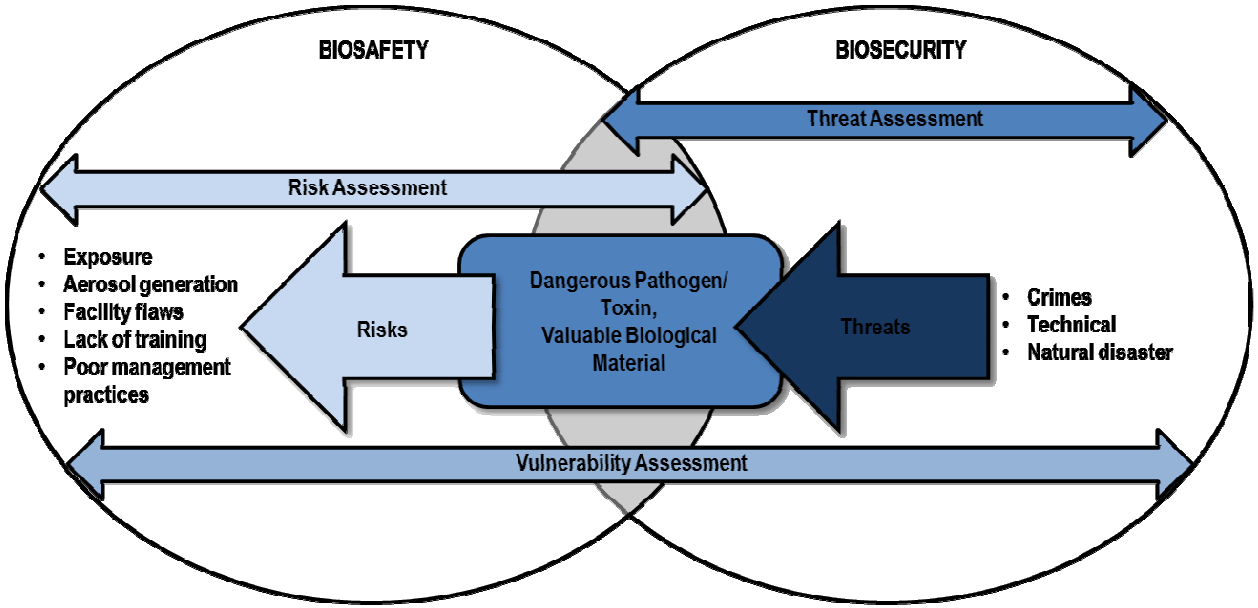
IDEALLY: BIOSAFETY & BIOSECURITY



Adapted from: *Biosecurity: Understanding, Assessing, and Preventing the Threat.* R. Burnette (Ed). Wiley. 2013

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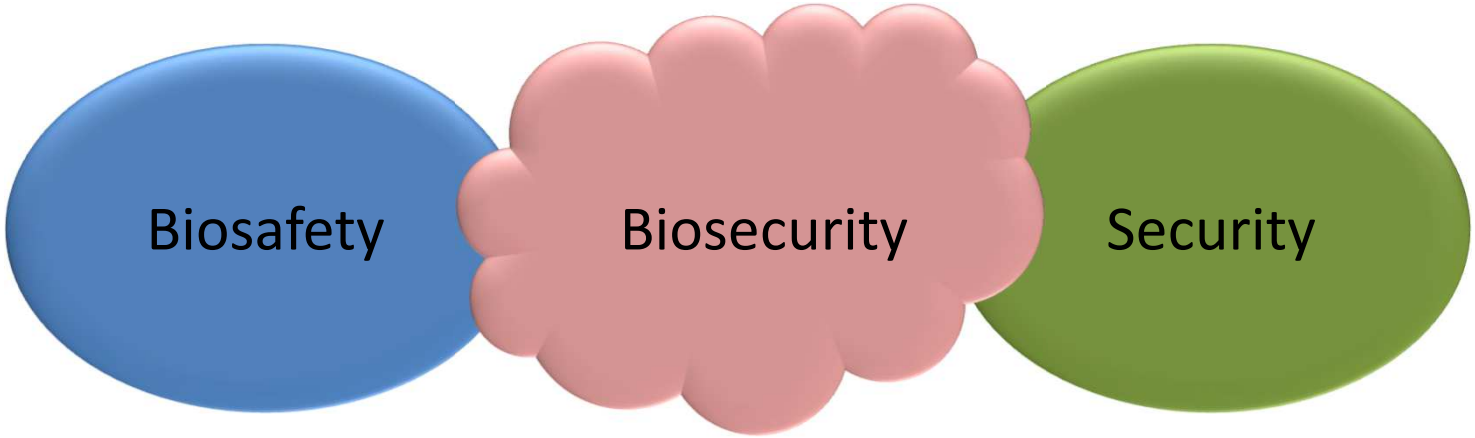
REALITY: BIOSAFETY & BIOSECURITY



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LABORATORY ENVIRONMENT

- Mixed levels of technical expertise (student, manager, technician, management, administration, EHS, security, emergency response, HR)
- Wide distribution of demographics, national origin
- Are a workplace
- Maintain stores of infectious agents
- Pressure to produce and publish

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LAB INSIDER THREATS

- **Malicious**

- **Negligent**

- **Benevolent**

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LAB INSIDER THREATS

- **Malicious**
  - Graduate student not having good luck
  - For months, no project works for anyone
  - Caught spiking lab-grade, shared water supply with bleach
  - Financial loss in excess of $60,000

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LAB INSIDER THREATS

- **Malicious**
  - Yale University veterinary technician
  - Pled guilty to murdering grad student Annie Le in 2009
  - Frequently complained about animal welfare

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LAB INSIDER THREATS

- **Negligent**
  - Graduate student working with regulated biological material
  - Transport of materials in lab coat pocket
  - Takes lab coat home to wash
  - Samples transported out of lab accidentally

Holy crap!

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LAB INSIDER THREATS

- **Benevolent**
  - Dr. Klaus Nielsen: Well-respected Canadian scientist stole samples of *Brucella*
  - Intent was to develop cheaper diagnostic kits for China and others

http://ottawacitizen.com/news/local-news/no-jail-for-scientist-who-tried-to-smuggle-deadly-bacteria-defence-argues

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LAB INSIDER THREATS

- **Benevolent**
  - Canadian Food Inspection Agency suffers reputational losses
  - Licensed competitor reported losses ~$10,000,000

CFIA·ACIA

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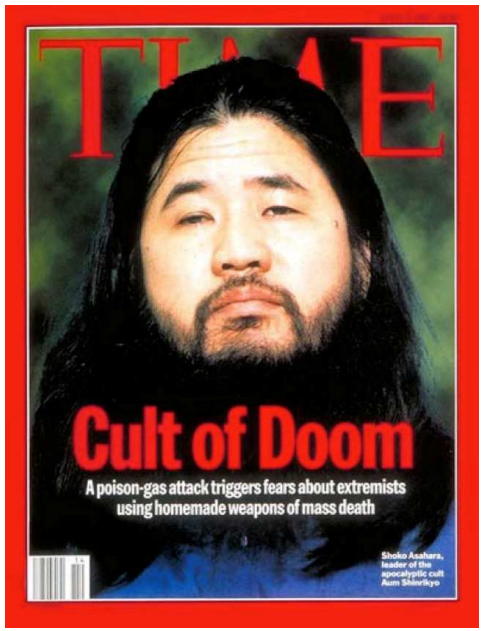
OUTBREAKS: THREAT MANAGEMENT

- Aum Shinrikyo cult/ terrorist organization has a history with EVD
- 1992, sent 40 medical personnel to Zaire to support local EVD outbreak
- Tried to obtain EVD samples
- Ultimately failed



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OUTBREAKS: THREAT MANAGEMENT

- The Challenge: how do you institute TM practices when you have a widespread medical emergency?
  - *Today, Doctors Without Borders still does not have an accurate account of how many frontline medical workers they sent to West Africa in 2014-15*

http://www.nationalturk.com/en/ebola-panic-in-west-africa-death-toll-of-ebola-reaches-328-in-republic-of-guinea-breaking-news-51329/

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OUTBREAKS: THREAT MANAGEMENT

- The Challenge: how do you institute TM practices when you have a widespread medical emergency?
  - *Tons of infectious waste say unattended for weeks waiting for incineration.*

https://noharm-global.org/articles/news/global/gghh-webinar-series-free-webinar-ebola-and-health-care-waste-lessons-west

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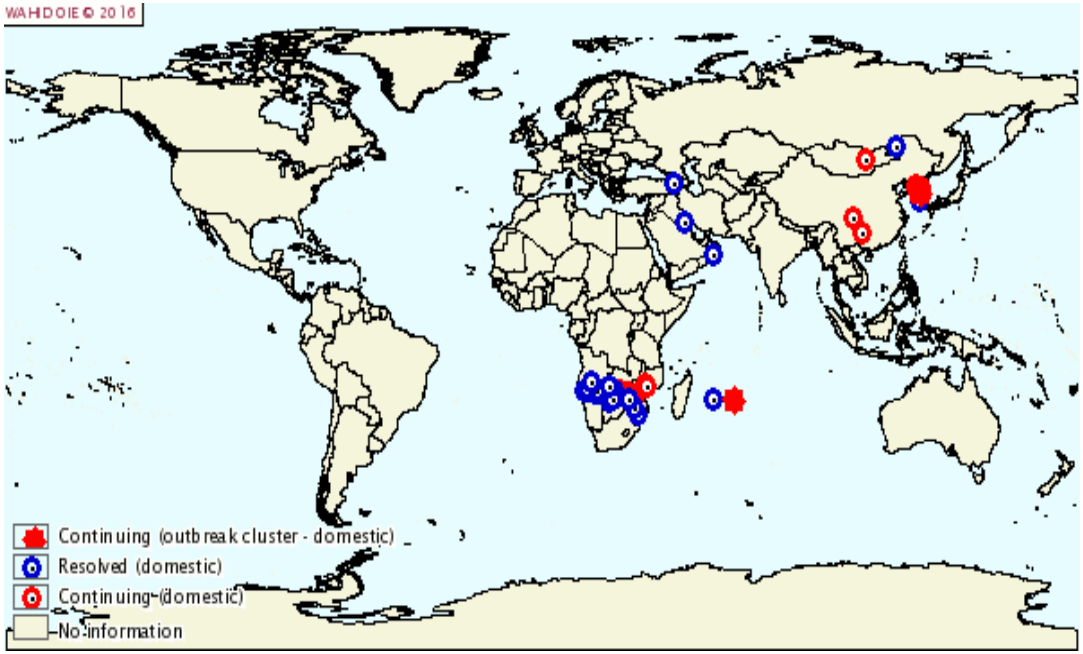
OUTBREAKS: THREAT MANAGEMENT

- The Challenge: how do you institute TM practices when you have a widespread medical emergency?
  - *Everyday, there are dozens of reported or emerging "hotspots" of dangerous infectious disease.*



www.oie.int

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THE REALITY

- We will likely never truly secure outbreak incidents.
- ***But what can be done?***

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ADAPTING THE 5 PILLARS

Pillar	Laboratory	Field
Physical	Locks, doors, fences, biometrics	Zoning and compartmentalization, facility-level biosecurity; movement controls; wildlife controls; trespassing
Information	Firewalls, IT systems	Reporting access, comms., info sharing and dissemination; joint training across disciplines
Material	Inventory mgmt., access control	Waste mgmt. in EVD outbreak; access to infectious waste; carcass management
Personnel	Background checks, screening, observation, reporting, training	Lack of education, training, experience, credentialing, “disease discrimination”
Transport	Licensing, training, regulations	Movement controls (samples, infected), trade restrictions; zoning

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PART FOUR

- **How to Move Forward**
  - *Biosecurity for Security Professionals*

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BIOSECURITY: THREAT MANAGEMENT

- **Threat management** = implementation of control measures to minimize, mitigate and manage threats & hazards
- **Biosecurity** = implementation of control measures necessary to minimize threats, and safeguard, biological agents/VBM

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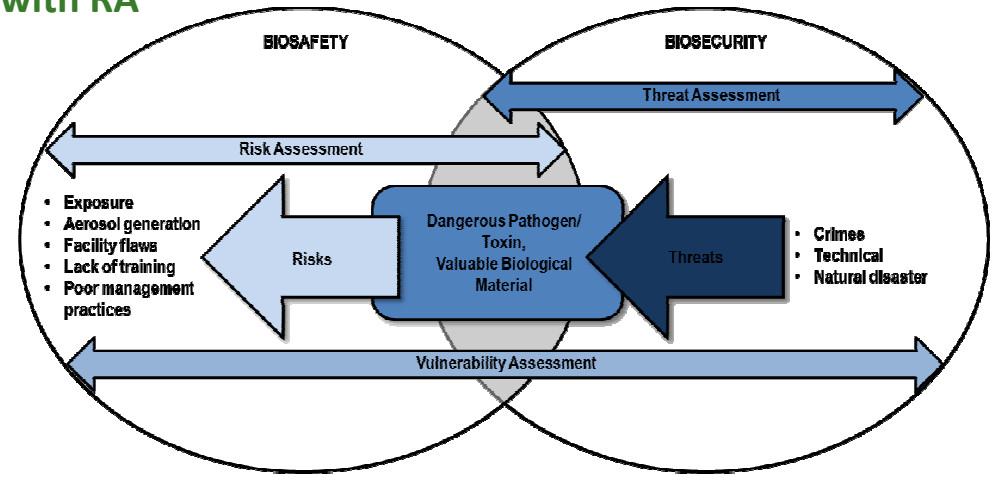
BIOSECURITY: THREAT MANAGEMENT

- **When you build Biosecurity, you're building TM**
- **Again, based on TA and VA, integrated with RA**
- **Components:**
  - *Administrative controls*
    - *Policy statement*
    - *Program plan*
    - *SOPs*
  - *Training and drills*
  - *Personnel suitability and reliability*
  - *Material control and accountability*
  - *Management and implementation*



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BIOSECURITY: IMPLEMENTATION

- **Implementation begins with knowledge**
  - **Biosafety personnel need to understand security/ threat management**
  - **Threat management professionals need to understand biological assets intrinsic attributes**

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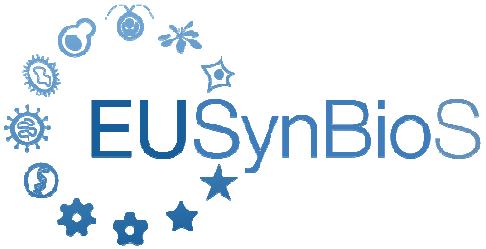
BIOSECURITY: IMPLEMENTATION



INTERPOL

PROFESSIONAL CREDENTIALING

- Registered Biosafety Professional
- Certified Biological Safety Professional

- Certified Threat Manager

PART FIVE

- **Summary**
  - *What can we do?*

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SUMMARY

- Biosecurity is distinct from biosafety, and traditional security, rooted in threat management
- Convergence of factors makes this “when,” not “if”
- Labs and outbreaks are at risk
- No definition of a “Biosecurity Professional”
- ***It’s time to talk***

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ACKNOWLEDGEMENTS

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Go Raibh Maith Agat

"May you have goodness"

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