CDC LABORATORY SYSTEMS, PATHOLOGY AND DIAGNOSTIC ROLE IN GLOBAL HEALTH

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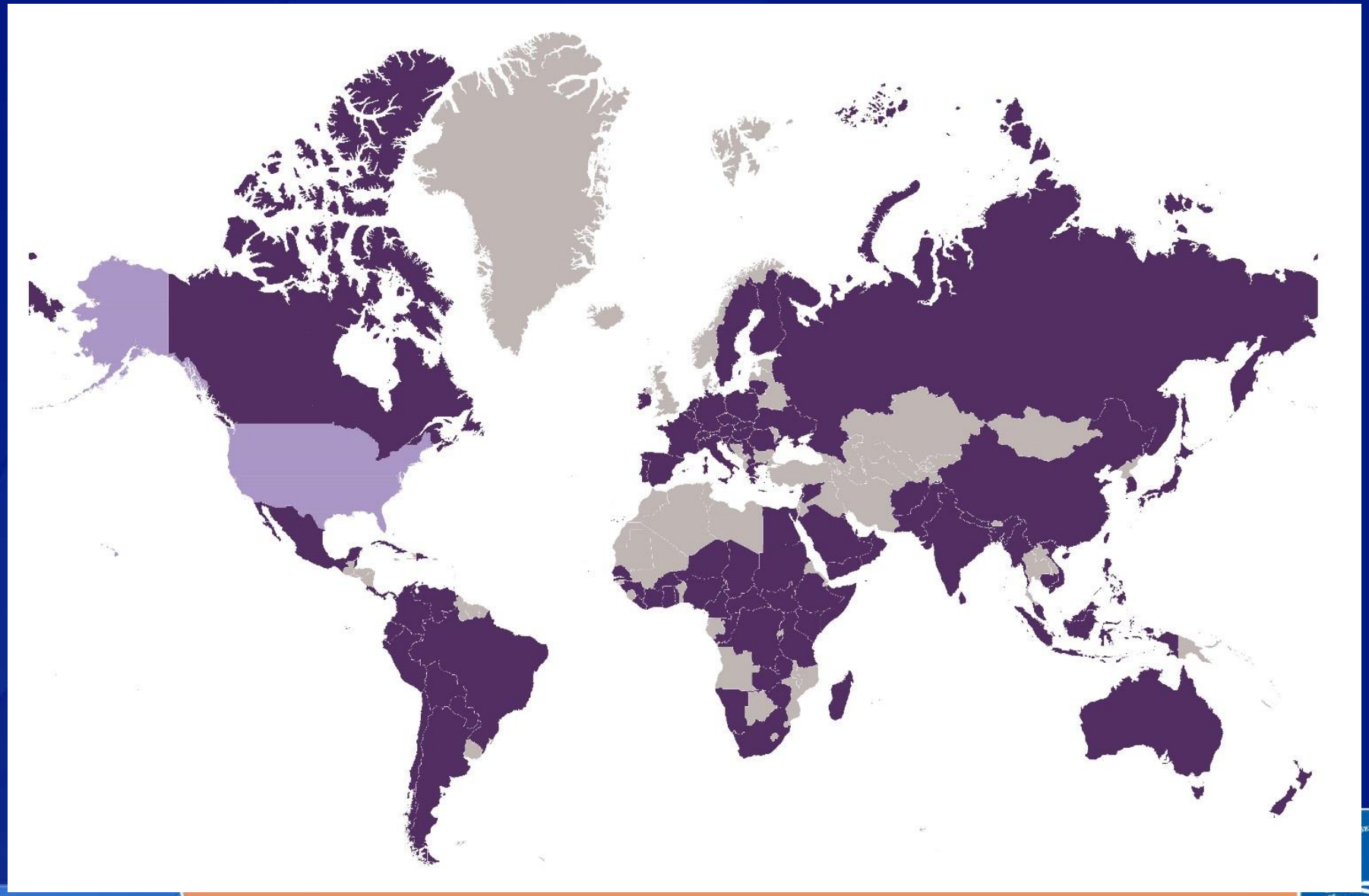
History of CDC

On July 1, 1942 the Communicable Disease Center (CDC) opened its doors and occupied one floor of a small building in Atlanta. Its primary mission was simple yet highly challenging: prevent malaria from spreading across the nation. Armed with a budget of only $10 million and fewer than 400 employees, the agency's early challenges included obtaining enough trucks, sprayers, and shovels necessary to wage war on mosquitoes.

A health threat anywhere is a health threat everywhere

Source: The Lancet 380:9857, 1-7 Dec 2012, pp. 1946-55. www.sciencedirect.com/science/article/pii/S0140673612611519introductions of vector-borne pathogens are probable

Countries with Outbreaks Reported by GDDOC in 2017

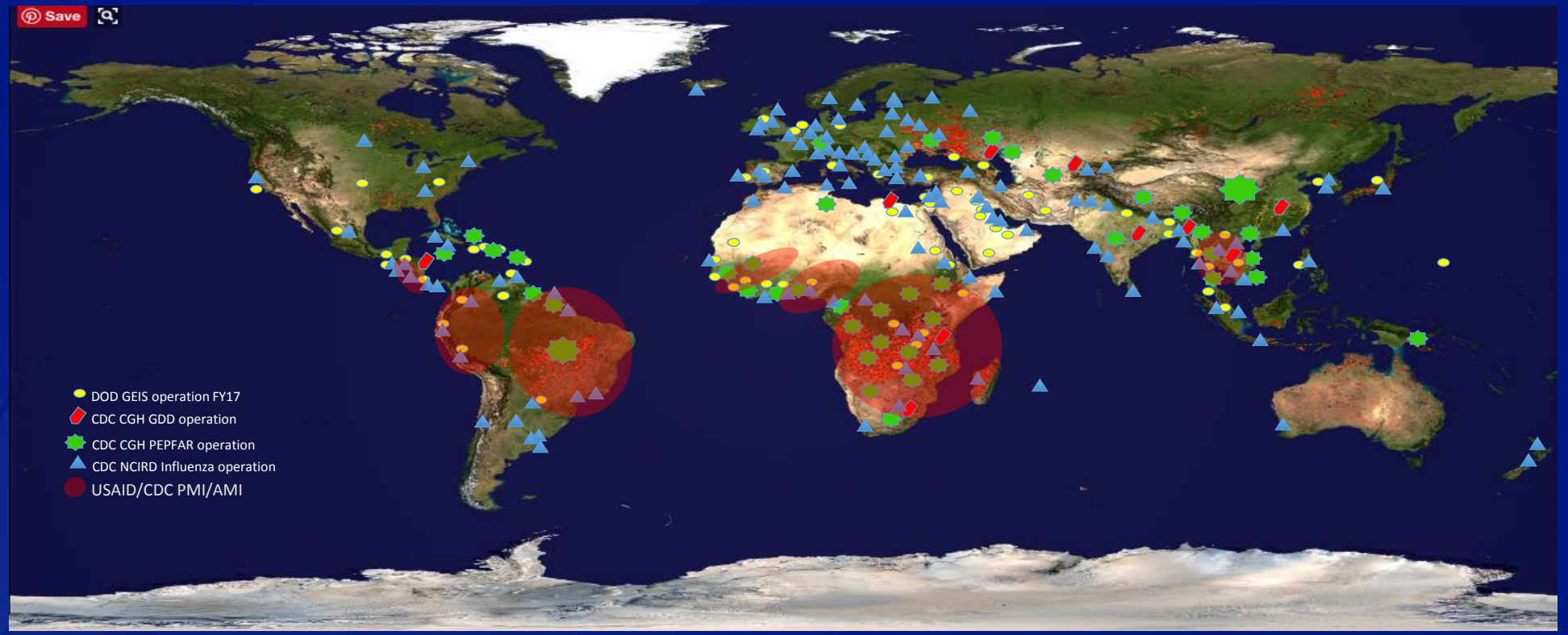


CDC LABORATORIES

1700+ SCIENTISTS
200+ LABS
1 MISSION

PROTECT. AMERICANS. 24/7.

Existing Capacity: USG



Shared Priorities

GLOBAL HEALTH SECURITY AGENDA

GHSA

INTERNATIONAL HEALTH REGULATIONS

IHR

LABORATORY

- Specimen referral network reaching > 80% of districts
- National reference laboratory performing 6 testing methods under IHR

Surveillance

- >3 core syndromes & confirmed reportable infections
- Capacity to analyze and link data for functional real-time biosurveillance

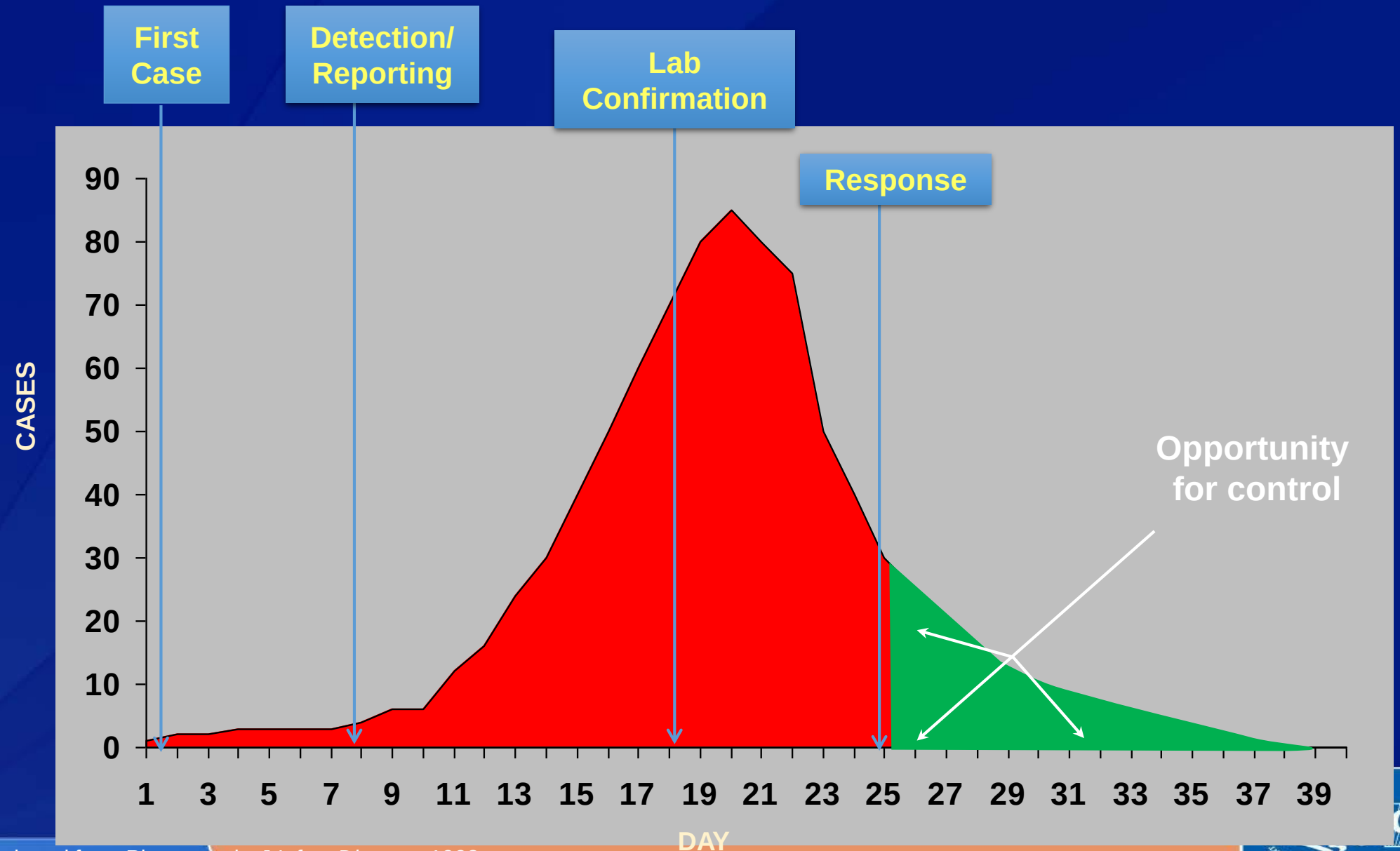
WORKFORCE DEVELOPMENT

- National workforce planning
- Minimum of 1 trained field epidemiologist per 200,000

EMERGENCY OPERATIONS

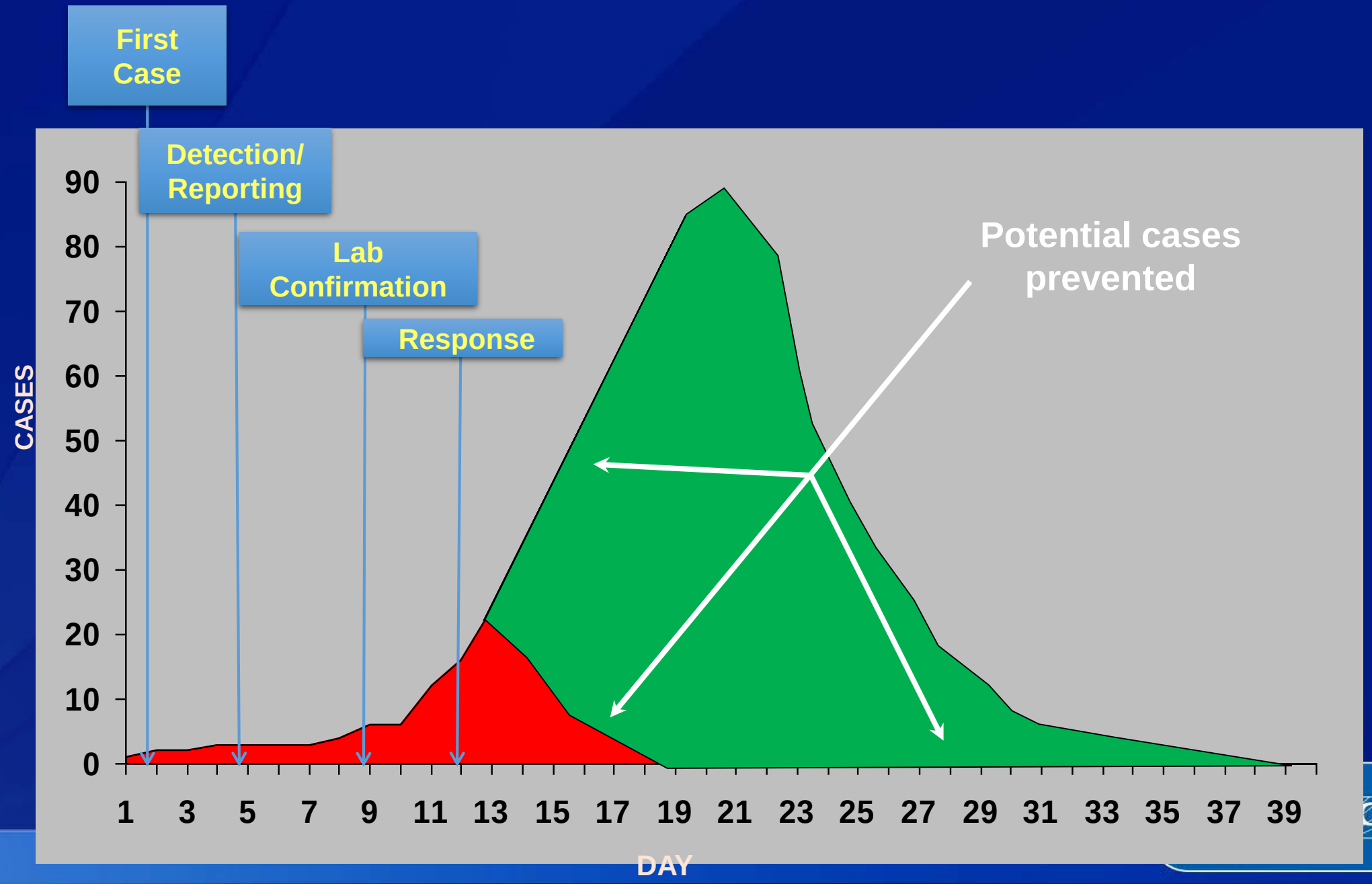
- EOC activation when needed
- Functional IMS use for preparedness and response

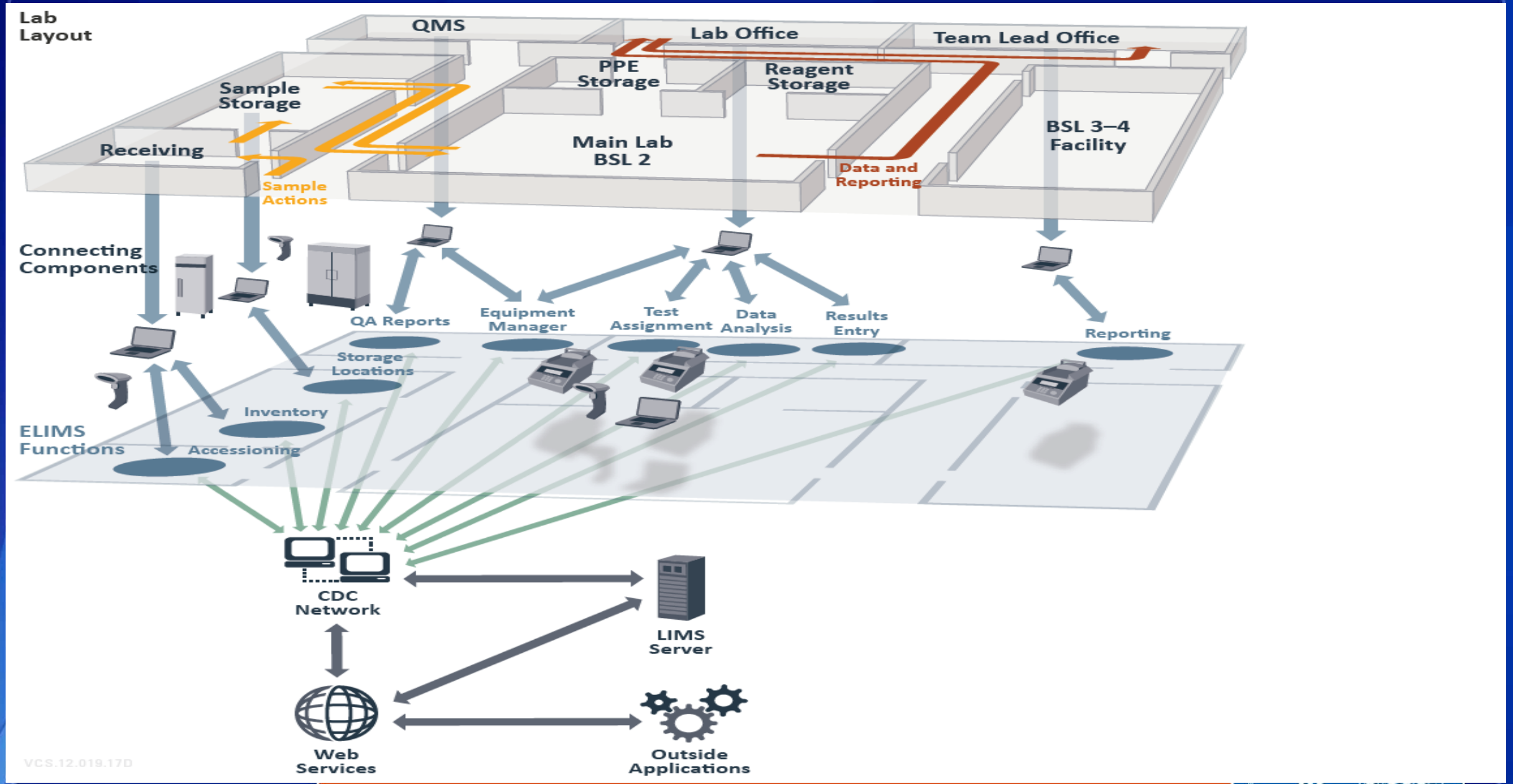
Without capacity for early detection & response



Developed from Pinner et al., *J Infect Diseases*1992

If surveillance & response system is effective – *Lab + reporting*

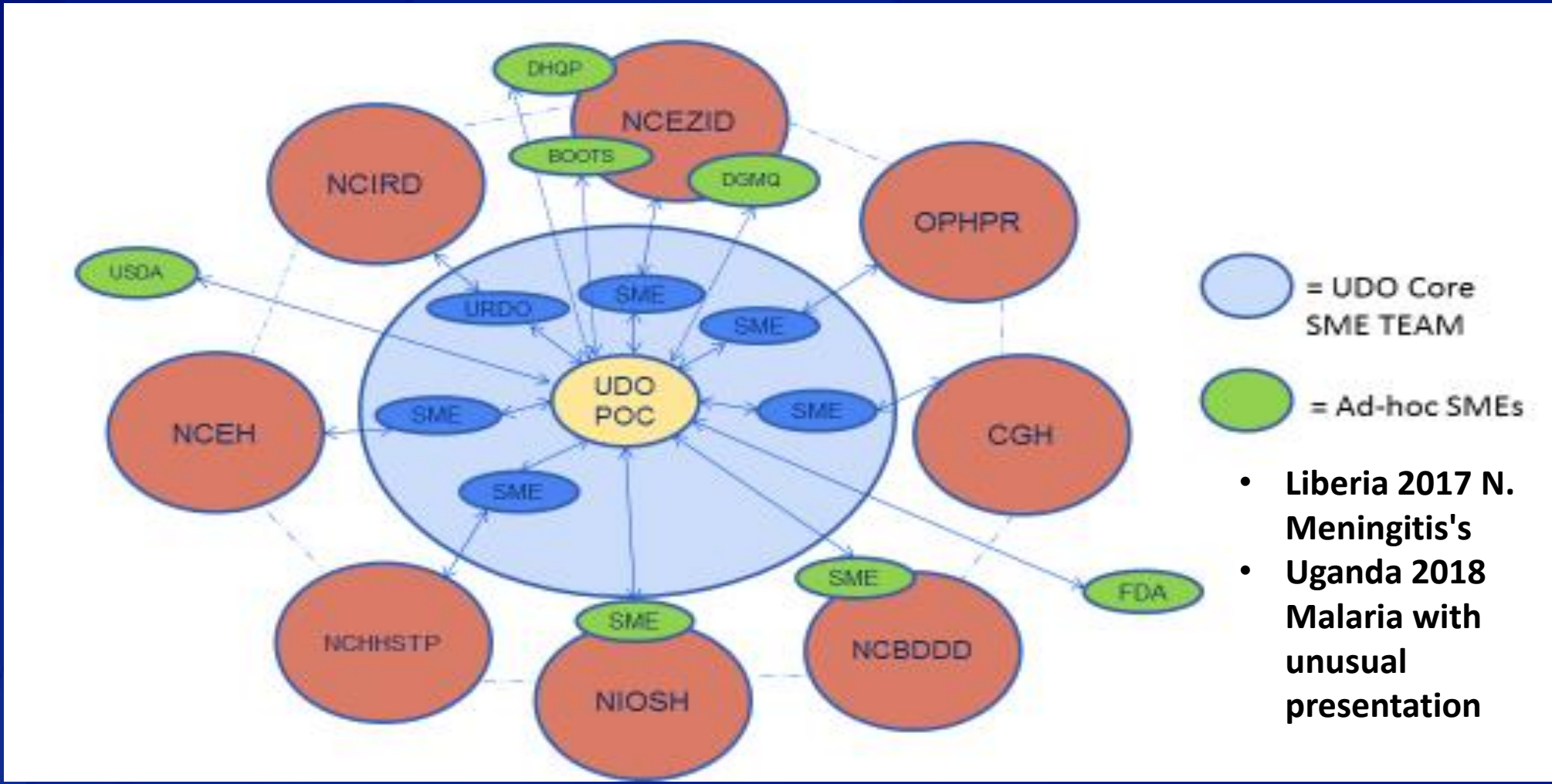



Lab Layout
QMS
Lab Office
Team Lead Office
PPE Storage
Reagent Storage
Sample Storage
Receiving
Main Lab BSL 2
BSL 3–4 Facility
Data and Reporting
Sample Actions
Connecting Components
QA Reports
Equipment Manager
Test Assignment
Data Analysis
Results Entry
Reporting
Storage Locations
Inventory
ELIMS Functions
Accessioning
CDC Network
LIMS Server
Web Services
Outside Applications
VCS.12.019.17D

Emergency Operations Center
Crisis/Outbreak Management

- Deployment
- Logistics
- Epidemiology
- Surveillance
- Lab support
- Response coordination

Unknown Disease Outbreaks Algorithm



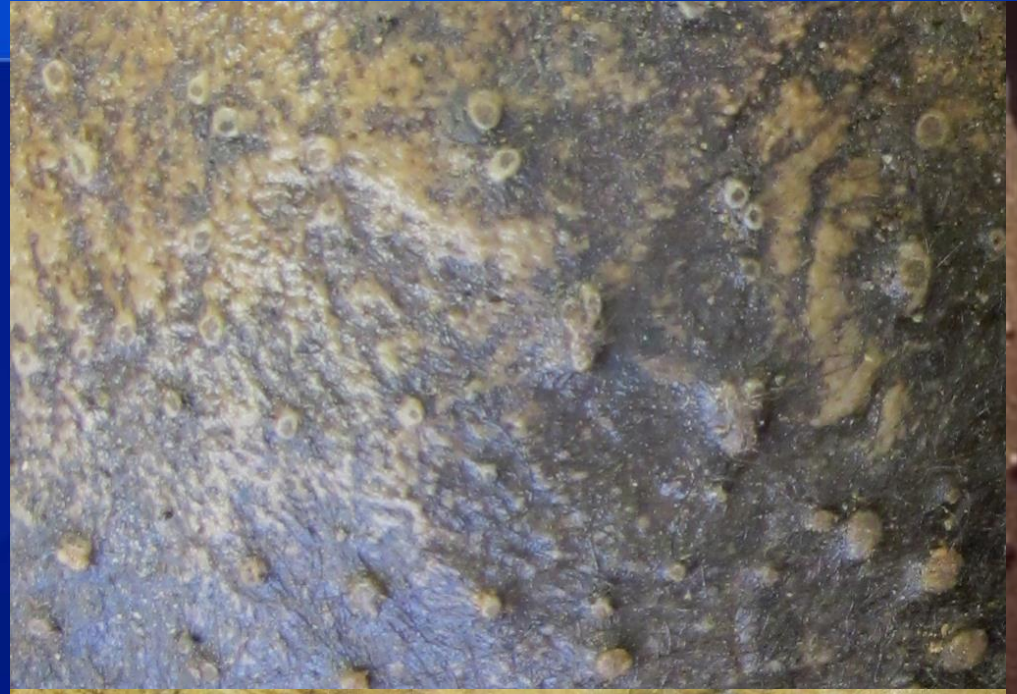
- **Liberia 2017 N. Meningitis's**
- **Uganda 2018 Malaria with unusual presentation**

Applications of laboratory diagnostics and pathology:

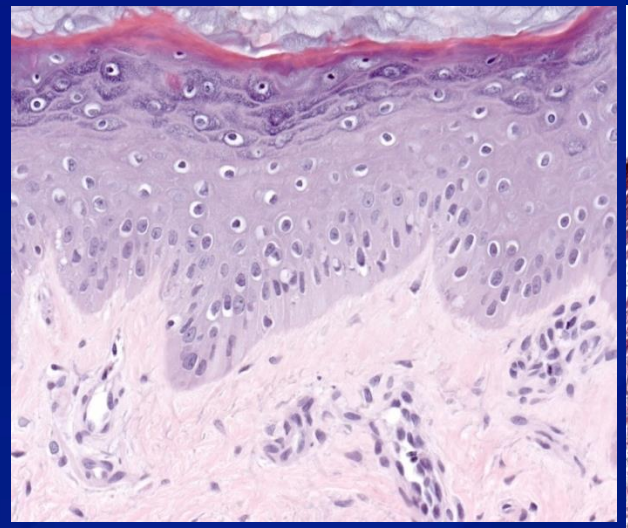
- I.D. Outbreak Response
  - Ebola in West Africa
  - Zika in the Americas
- Potential threats
  - Exposure to pandemic threats (specific threat rule in/out-Ebola, flu)
  - Queens “Lady in the iron coffin”-Smallpox
- Surveillence and evidence based clinical study
  - CHAMPS

Physical appearance is consistent with smallpox

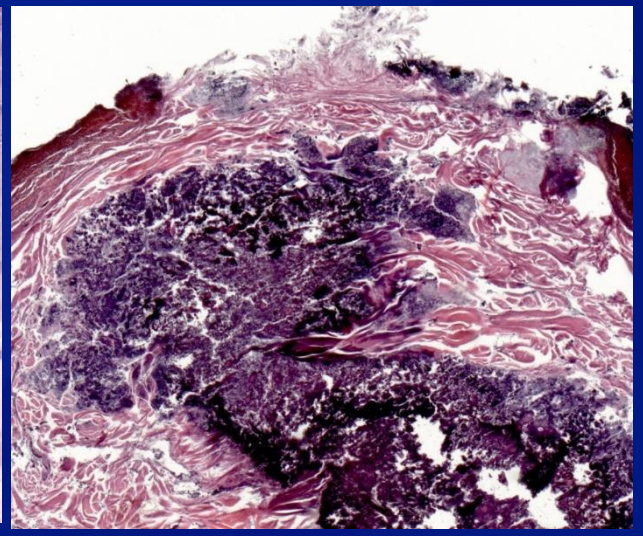
- Umbilicated lesions
- Firm to touch
- Gross pathology
- Lesion distribution



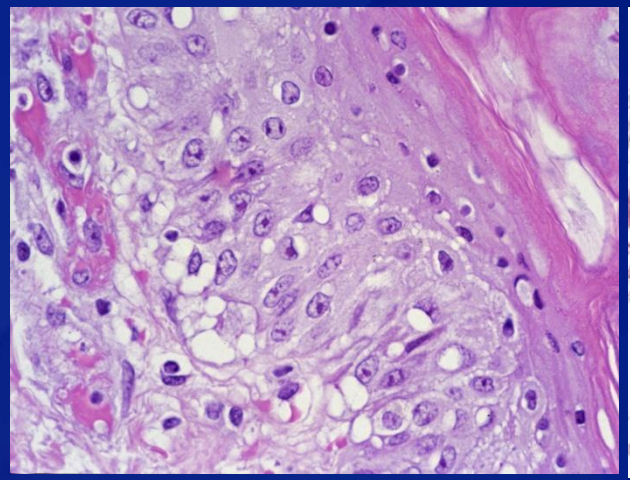
Patient lesions
C. 1968



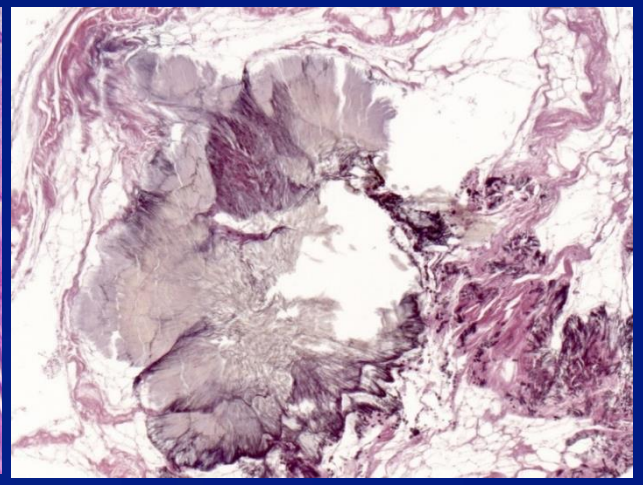
“Normal” skin



Mummy skin

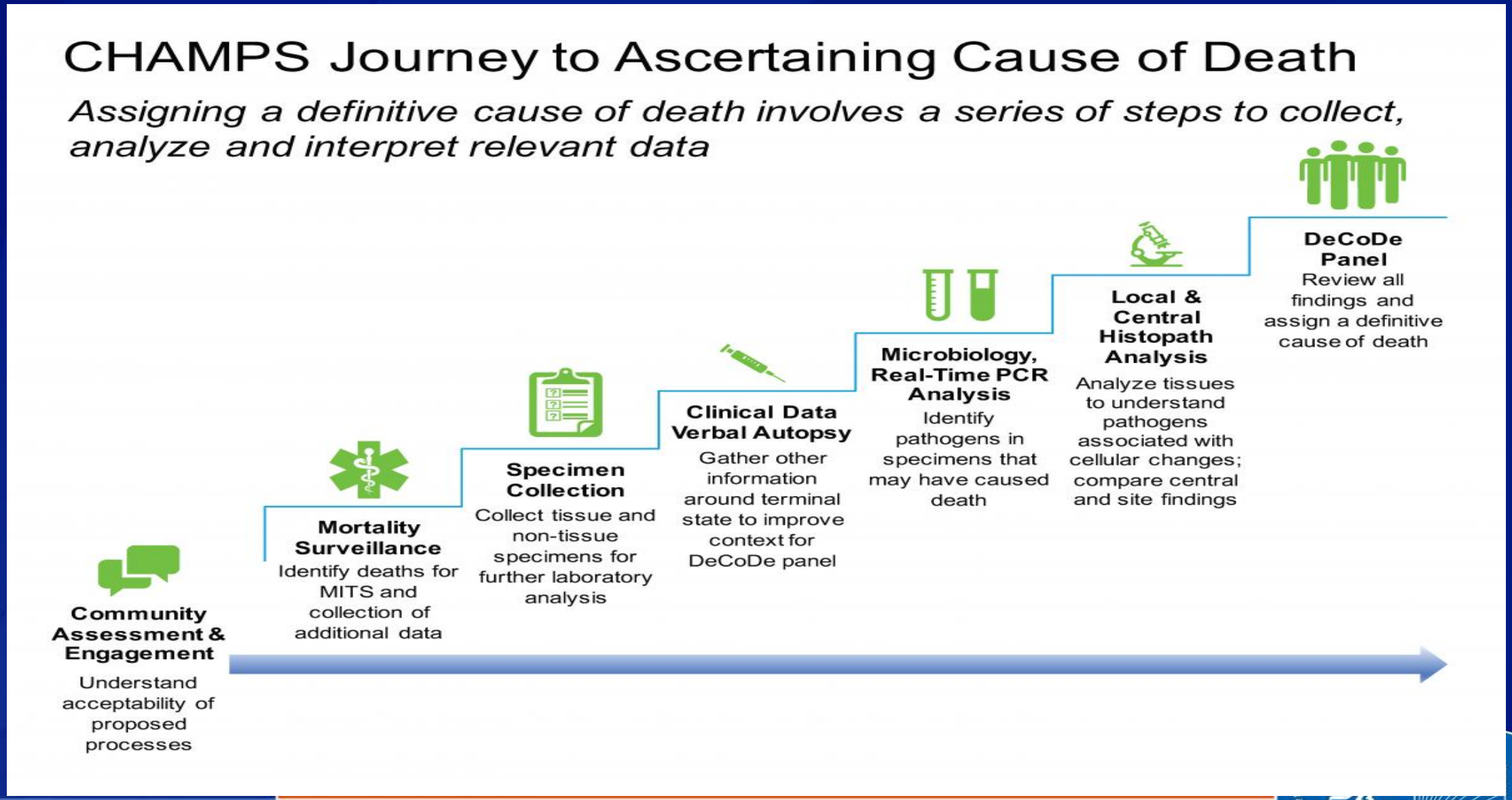


Smallpox in skin



The tissue was poorly preserved so difficult to conclude presence of virus

CHAMPS STUDY-a model for use of pathology and laboratory diagnostics



Summary of Specimen Diagnostics (All)

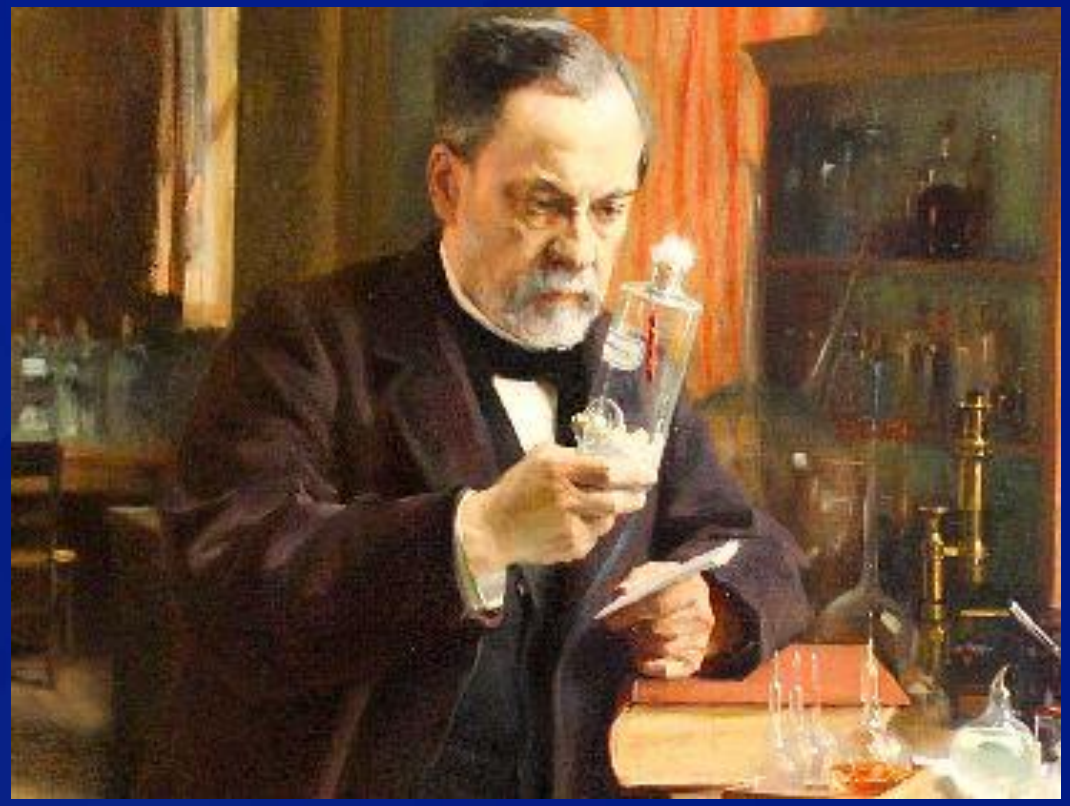
		In-Country					Central Lab			
	Specimen Type	*Path*	*Culture*	*GeneXpert TB*	*TAC*	*Storage (frozen)*	*Path*	*Culture*	*TAC‡*	*Storage (frozen)*
Deaths	***Tissue***									
	Brain	X				X	X			X
	Lung	X		X	X	X	X		5-10%	X
	Heart	X				X	X			X
	Liver	X				X	X			X
	Placenta	X				X	X			X
	Umbilical cord	X				X	X			X
	Bone Marrow	X					X			
	Spleen/Kidney*	X					X			
	Skin*	X					X			
	Lymph nodes*	X				X	X			X
	Non-Tissue									
	Blood		X		X	X			5-10%	X
	Stool			X	X	X			5-10%	X
	NP/OP swab				X	X			5-10%	X
	CSF		X		X	X			5-10%	X
	Hair*					X				X
	Urine*					X				X
Severely Ill	***Non-Tissue***									
	Blood		X		X	X			5-10%	X
	Stool			X	X	X			5-10%	X
	NP/OP swab				X	X			5-10%	X
	NP aspirate†			X	X					
	CSF (if indicated)		X		X	X			5-10%	X
	Hair*					X				X
	Urine*					X				X

*Only collected under extended protocol
†Only collected if child has severe respiratory illness
‡ For QA/QC

CHAMPS

- Identify infectious agents
- Integrative pathology and diagnostic analysis
- Comparative epidemiology
- Specificity of syndromic cause
- Identification of mortality cause

- **“Without laboratories men of science are soldiers without arms.”**



Louis Pasteur in his laboratory. The red object in the jar is the spinal cord of a rabbit infected with rabies. He used this to develop the rabies vaccine.