Examples & Evaluation of Surveillance Programs

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Objectives

- Review attributes of a surveillance system
- Discuss assessment for surveillance systems

Post Questions in the Chat!

(we will have breaks to answer these during the workshop)

Workshop Schedule

Time	Topics
2:00–2:15 pm	Additional Points on Assessment
2:15–3:00 pm	Example Assessments
3:00–3:10 pm	Break
3:10–4:00 pm	Mapping in R

Evaluation & Assessment

(continued)

Attributes of Surveillance Systems

- Continuous, ongoing data collection
- Efficient, practical, timely
- Flexible, acceptable
- Sensitive, representative
- Direct link between outputs and action

Evaluation & Assessment

- looking whole system
- looking at programs
- attributes

- Qualitative & quantitative approaches
  - qualitative: describing system or program in detail, assess attributes
  - quantitative: calculations, statistical analysis of attributes
- Each approach is valuable and provides different information
  - some approaches can only be evaluated in one way

Guidelines for Evaluations

- General assessment for surveillance systems:
  - CDC (2001), Updated guidelines for evaluating public health surveillance systems. *MMWR* 50(RR13): 1-35.
- Specific assessment of surveillance program
  - CDC (2004), Framework for evaluating health surveillance systems for early detection of outbreaks. *MMWR* 53(RR05): 1-11.

all system

early detection focus

Checklist for Evaluating Public Health Surveillance Systems

Tasks for evaluating a surveillance system*	Page(s) in this report
☐ Task A. Engage the stakeholders in the evaluation	4
☐ Task B. Describe the surveillance system to be evaluated	4–11
☐ 1. Describe the public health importance of the health-related event under surveillance	4– 5
☐ a. Indices of frequency	
☐ b. Indices of severity	
☐ c. Disparities or inequities associated with the health-related event	
☐ d. Costs associated with the health-related event	
☐ e. Preventability	
☐ f. Potential future clinical course in the absence of an intervention	
☐ g. Public interest	
☐ 2. Describe the purpose and operation of the surveillance system	5–10
☐ a. Purpose and objectives of the system	
☐ b. Planned uses of the data from the system	
☐ c. Health-related event under surveillance, including case definition	
☐ d. Legal authority for data collection	
☐ e. The system resides where in organization(s)	
☐ f. Level of integration with other systems, if appropriate	
☐ g. Flow chart of system	
☐ h. Components of system	
☐ 1) Population under surveillance	
☐ 2) Period of time of data collection	
☐ 3) Data collection	
☐ 4) Reporting sources of data	
☐ 5) Data management	
☐ 6) Data analysis and dissemination	
☐ 7) Patient privacy, data confidentiality, and system security	
☐ 8) Records management program	
☐ 3. Describe the resources used to operate the surveillance system	10–11
☐ a. Funding source(s)	
☐ b. Personnel requirements	
☐ c. Other resources	
☐ Task C. Focus the evaluation design	11–12
☐ 1. Determine the specific purpose of the evaluation	
☐ 2. Identify stakeholders who will receive the findings and recommendations of the evaluation	
☐ 3. Consider what will be done with the information generated from the evaluation	
☐ 4. Specify the questions that will be answered by the evaluation	
☐ 5. Determine standards for assessing the performance of the system	
☐ Task D. Gather credible evidence regarding the performance of the surveillance system	13–24
☐ 1. Indicate the level of usefulness	13–14
☐ 2. Describe each system attribute	14–24
☐ a. Simplicity	
☐ b. Flexibility	
☐ c. Data quality	
☐ d. Acceptability	

Example: Early Warning Systems

Keita M *et al*. (2021), Evaluation of early warning, alert, and response system for Ebola virus disease, Democratic Republic of the Congo, 2018—2020. *Emerg Infect Dis* 27(12): 2988—2998.

Ebola Virus Disease

- Two largest outbreaks of Ebola virus disease (EVD) in recorded history
  - WHO → Public Health Emergencies of International Concern
- Rapid spread with high rates of morbidity and mortality
  - early detection is important for outbreak response
  - clear case definitions for screening tools, suspected case referral, identification of cases

GLOBAL HEALTH

W.H.O. Continues Emergency Status for Ebola Outbreak in Congo

New cases are down to 15 a week from a high of 128 in April, but outbreaks are still popping up in remote and dangerous mining areas.

By DONALD G. MCNEIL JR.

GLOBAL HEALTH

You're Swabbing a Dead Gorilla for Ebola. Then It Gets Worse.

Carrion flies inside your hood. Sweat turns your gloves into water balloons. This is tough work, but it could predict disease outbreaks.

By DONALD G. MCNEIL JR.

Health Experts Fight Ebola in Congo, and Each Other

As the epidemic rages in a violent, embattled region, two important players — the World Health Organization and Doctors Without Borders — clash over how to end it.

By DENISE GRADY

GLOBAL HEALTH

As Congo's Ebola Outbreak Drags On, Untracked Cases Sow Confusion

On tour in Africa, American officials said the U.S. would keep providing aid. But Congo's response has been uneven, and the former health minister has been jailed.

deceased

Appendix Table. Case definitions of Ebola virus disease for all ages as established by the World Health Organization

Suspected case	Confirmed case	Probable case	Non-case
Any person, alive or dead, suffering or having had a sudden onset of high fever and having had contact with: -a suspected, probable or confirmed Ebola case; -a dead or sick animal OR: any person with sudden onset of high fever and ≥3 of the following symptoms: headaches; vomiting; anorexia/loss of appetite; diarrhea; lethargy; stomach pain; aching muscles or joints; difficulty swallowing; breathing difficulties; hiccup OR: any person with inexplicable bleeding OR: any sudden, inexplicable death.	Any suspected or probable cases with a positive laboratory result; laboratory-confirmed cases must test positive for the virus antigen, either by detection of virus RNA by RT-PCR, or by detection of IgM antibodies directed against Ebola.	Any suspected case evaluated by a clinician; OR any deceased suspected case (where it has not been possible to collect specimens for laboratory confirmation) having an epidemiologic link with a confirmed case. Note: if laboratory specimens are collected in due time during the illness, the preceding categories are reclassified as "laboratory confirmed" cases and "non-case."	Any suspected or probable case with a negative laboratory result. "Non-case" showed no specific antibodies, RNA, or specific detectable antigens.

no labs
clinical Symptoms

lab +

clinical
epi link

EVD Surveillance

- Democratic Republic of Congo has had multiple outbreaks of EVD
- Active conflict zones
- 10th EVD outbreak: August 2018—June 2020
  - poor public health indicators early on

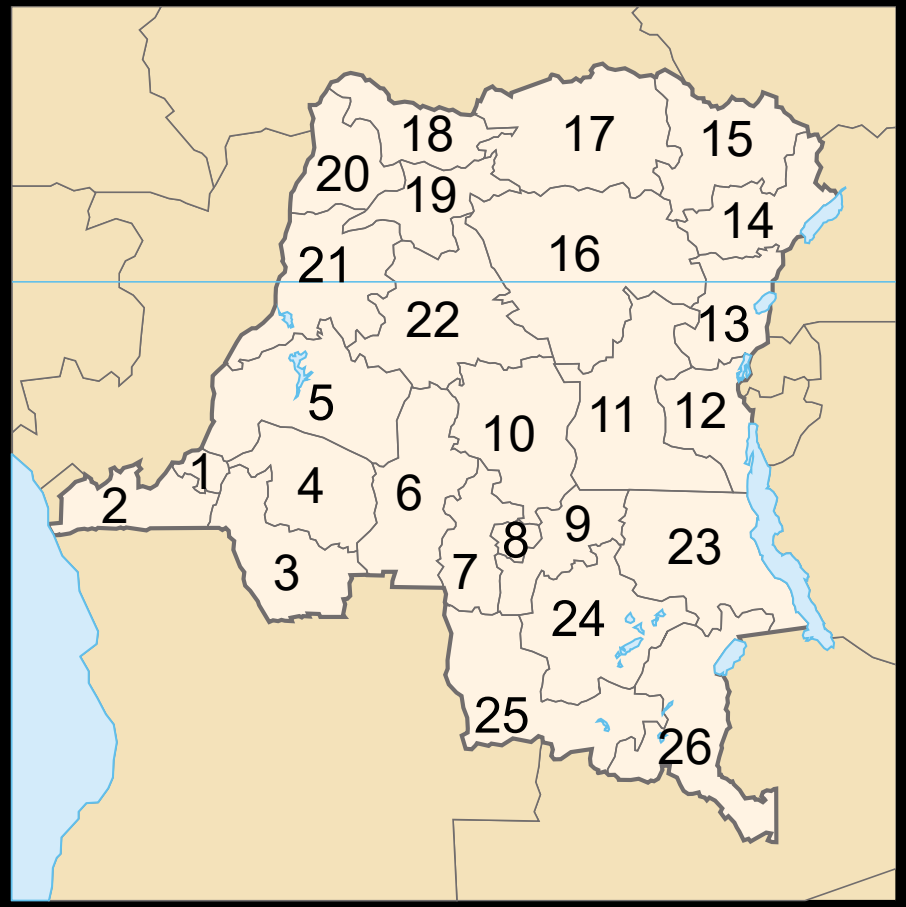


Image by Wikimedia Commons

EVD Surveillance

- 10th EVD outbreak: August 2018–June 2020
  - poor public health indicators early on
  - improvement through:
    - prompt investigation
    - early detection and isolation
    - enhanced community-based surveillance
    - rapid follow-up of high-risk contacts
    - adaptive vaccination
    - Early Warning, Alert and Response System (EWARS)

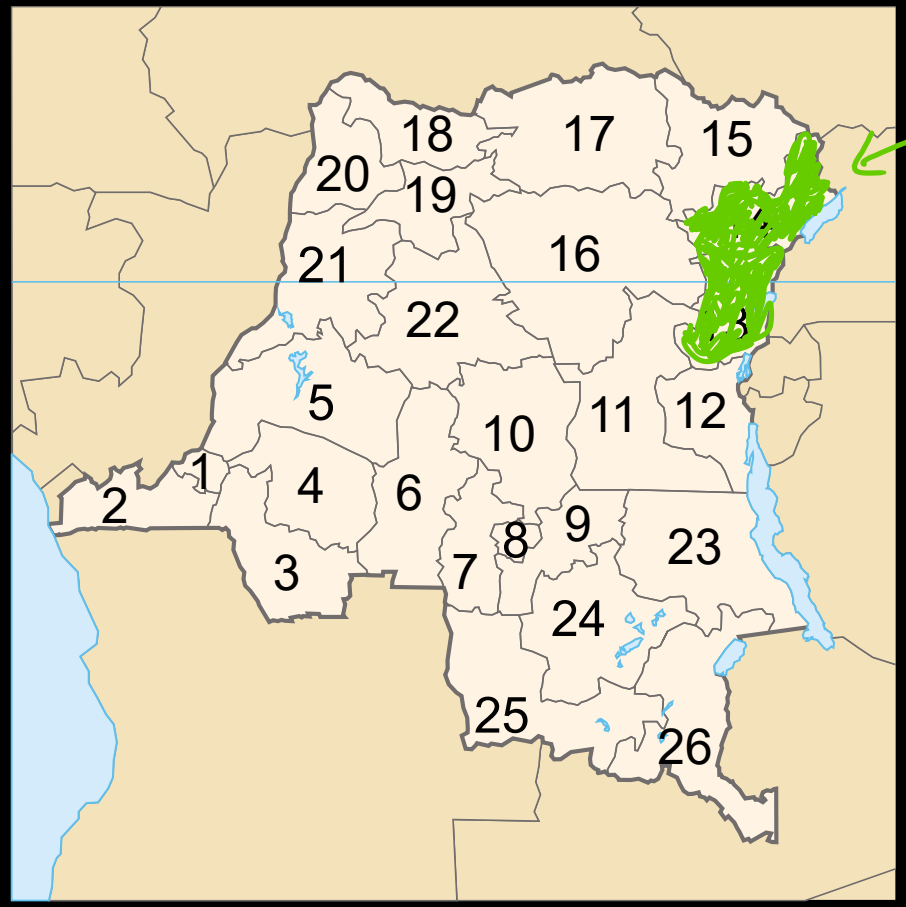


Image by Wikimedia Commons

EWARS Description

- Alert Unit
  - gather and assess alerts
  - coordinate investigations
  - organize referrals/transfers
- Database
  - paper-based alert and investigation forms
  - Microsoft Excel database

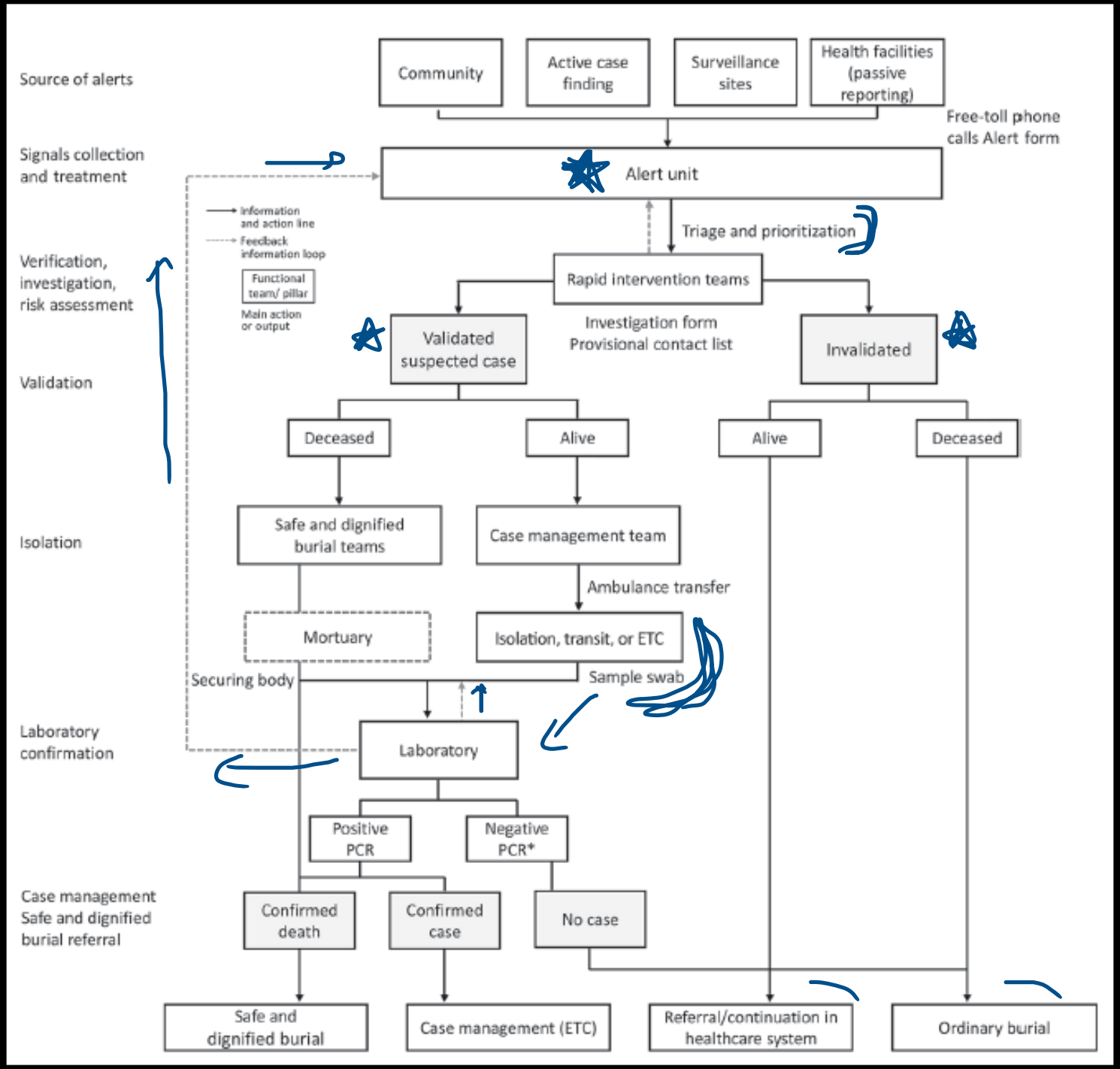
- People
  - operational coordinator
  - database/information admin
  - case management leader
  - Safe & Dignified Burial leader
  - 3 telephone operators
  - alert monitoring officer
  - database manager
  - data clerk
  - archivist

EWARS Description

- Rapid Investigation Teams
  - onsite investigation of alerts
    - detailed history
    - assess link
    - clinical symptoms
    - list of contacts
  - validate or invalidate alert
    - compare with suspected case definition
    - refer living suspected cases to transit, isolation or treatment centers
    - engage Safe & Dignified Burial team for deceased suspected cases

- People
  - field epidemiologist
  - infection prevention/control officer
  - communication officer
  - psycho-social worker

transmission risk


Source of alerts
Community
Active case finding
Surveillance sites
Health facilities (passive reporting)
Free-toll phone calls Alert form
Signals collection and treatment
Alert unit
Information and action line
Feedback information loop
Functional team/ pillar
Main action or output
Triage and prioritization
Verification, investigation, risk assessment
Rapid intervention teams
Investigation form
Provisional contact list
Validated suspected case
Invalidated
Validation
Deceased
Alive
Alive
Deceased
Isolation
Safe and dignified burial teams
Case management team
Ambulance transfer
Mortuary
Isolation, transit, or ETC
Securing body
Sample swab
Laboratory confirmation
Laboratory
Positive PCR
Negative PCR*
Case management Safe and dignified burial referral
Confirmed death
Confirmed case
No case
Safe and dignified burial
Case management (ETC)
Referral/continuation in healthcare system
Ordinary burial

EWARS Evaluation

- sensitivity
- positive predictive value
- timeliness

- representativeness
- usefulness

- stability

EWARS Evaluation

- sensitivity → reviewed case details for all alerts
- positive predictive value → calculated from above information
- timeliness → time between alert and investigation
- representativeness → check alert coverage
- usefulness → number of cases detected through EWARS
- stability → considered how system operated over time

demographic info

cost

EWARS Evaluation: Sensitivity

Table 2. Evaluation results and overall characteristics of Ebola virus disease alerts from EWARS, Democratic Republic of the Congo, August 5, 2018–June 30, 2020*0

	Suspected case definition			% (95% CI)			
Alert system	No. met	No. unmet	Total	Sensitivity	Specificity	PPV	NPV
Validated	15,163	15,561	30,724				
Invalidated	2,764	160,645	163,409				
Total	15,245	184,104	194,133	84.6 (84.1–85.1)	91.2 (91.0–91.3)	49.4 (48.8–49.9)	98.3 (98.2–98.4)

*Total excludes 434 (0.2%) alerts that were not investigated and 201 (0.1%) alerts that could not be classified according to the case definition due to missing data. EWARS, Early Warning, Alert and Response System; NPV, negative predictive value; PPV, positive predictive value.

Table 3. Evaluation of EWARS alerts by source of Ebola virus disease alert and health zone, Democratic Republic of the Congo, August 5, 2018–June 30, 2020

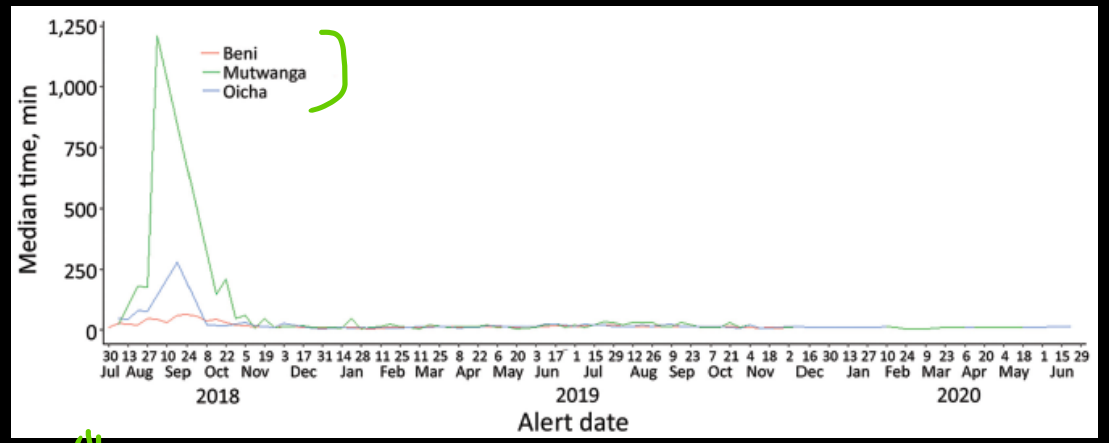
	% (95% CI)			
Category	Sensitivity	Specificity	PPV	NPV
Source of alert				
Active case finding/IPC	87.5 (86.9–88.1)	91.7 (91.6–91.9)	51.2 (50.4–51.9)	98.7 (98.6–98.7)
Community	91.4 (90.1–92.7)	93.6 (93.3–93.9)	48.3 (46.6–50.0)	99.4 (99.3–99.5)
Health facility	65.4 (63.8–67.0)	96.2 (96.0- 96.4)	64.5 (62.9–66.1)	96.4 (96.2–96.6)
Other surveillance sites	98.0 (97.4–98.7)	34.3 (33.0–35.6)	33.0 (31.7–34.2)	98.1 (97.5–98.8)
Health zone				
Beni	94.8 (94.4–95.2)	90.6 (90.5–90.8)	44.9 (44.3–45.5)	99.5 (99.5–99.6)
Mutwanga	54.9 (52.4–57.3)	96.4 (96–96.7)	68.2 (65.7–70.8)	93.8 (93.3–94.2)
Oicha	64.3 (62.8–65.8)	93.3 (92.8–93.8)	78.6 (77.2–80.1)	87.2 (86.6–87.9)

*EWARS, Early Warning, Alert and Response System; IPC, Infection Prevention and Control; NPV, negative predictive value; PPV, positive predictive value.

EWARS Evaluation

Timeliness

- investigation initiated within 2 hours: 96.6% of alerts



early on, timeliness was poor

Representativeness

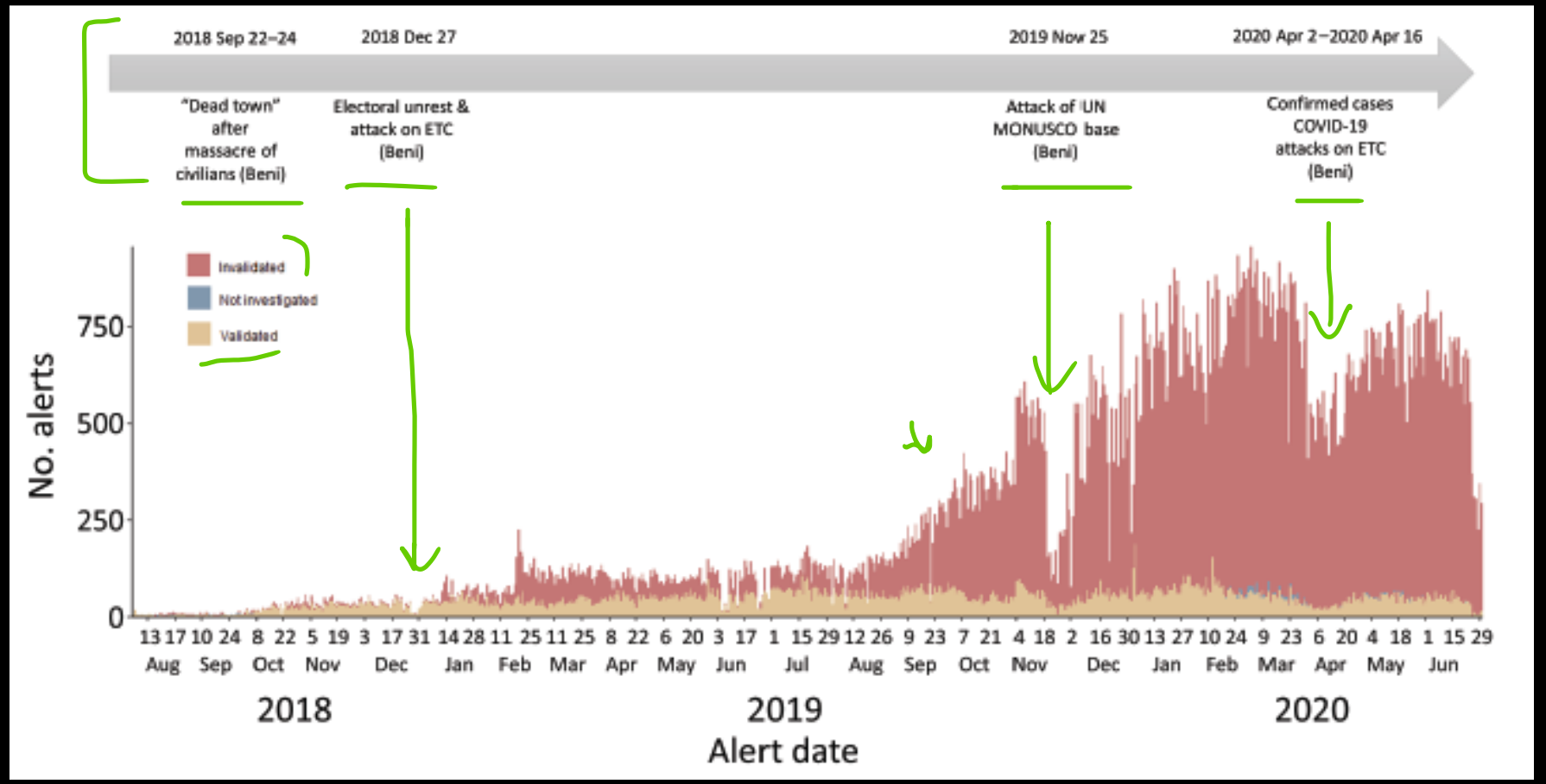
- Most alerts from Beni
- 56% female
- age groups
  - 24% children <5
  - 19% aged 20-29
  - 19% aged 10-19
  - 11% children 5-9

EWARS Evaluation: Usefulness & Cost

- For each case detected by EWARS
  - 242 alert notifications
  - 38 validated alerts
- $353,000 USD for implementation and operation over 2 years
  - $1.80 per alert notification
  - $438 per detected case

- what's the cost of undetected case?
  - lost productivity
  - need healthcare, more severe = more $$
  - spreading disease → more cases

EWARS Evaluation: Stability



EWARS Evaluation

- better metrics/attributes compared to surveillance systems used in previous EVD outbreaks
  - cheaper per case than notification/response systems used in previous outbreaks
- What worked well?
  - multiple sources for cases (active, passive, etc.)
  - based on stable and extensive telephone network (acceptable, accessible)
  - decentralized: comprehensive coverage and rapid response, teams dedicated at local level
- Limitations
  - funding/resources not available long-term
  - completeness, acceptability, flexibility difficult to assess

outbreak response (WHO)

Example: Data Collection in US Surveillance

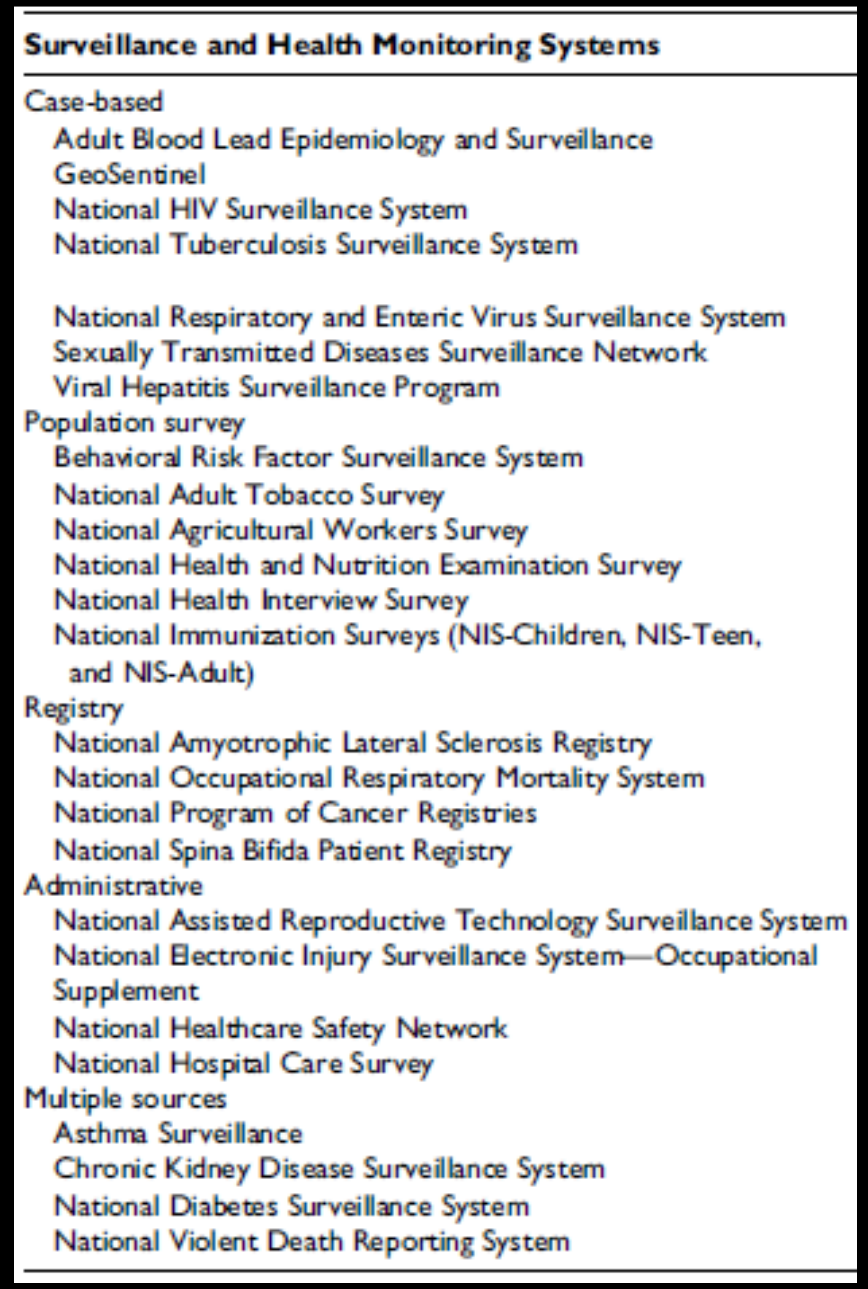
Rodriguez-Lainz A *et al*. (2018), Collection of data on race, ethnicity, language, and nativity by US public health surveillance and monitoring systems: gaps and opportunities. *Public Health Reports* 133(1): 45-54.

Diversity of US Populations

- major changes in US demographics
  - race, ethnicity, language use
  - 1965-2015: 59 million immigrants
  - 21% speak language other than English at home
- data on these characteristics necessary to assess health disparities
- completeness, usefulness, flexibility, (representativeness)

US Public Health Surveillance

- quantify changes in population health, identify & respond to challenges, evaluate effectiveness of public health programs
- surveillance & health monitoring
  - notifiable diseases
  - population-based surveys
  - vital records
  - disease registries
  - hospital discharges



Surveillance and Health Monitoring Systems
Case-based
Adult Blood Lead Epidemiology and Surveillance
GeoSentinel
National HIV Surveillance System
National Tuberculosis Surveillance System
National Respiratory and Enteric Virus Surveillance System
Sexually Transmitted Diseases Surveillance Network
Viral Hepatitis Surveillance Program
Population survey
Behavioral Risk Factor Surveillance System
National Adult Tobacco Survey
National Agricultural Workers Survey
National Health and Nutrition Examination Survey
National Health Interview Survey
National Immunization Surveys (NIS-Children, NIS-Teen, and NIS-Adult)
Registry
National Amyotrophic Lateral Sclerosis Registry
National Occupational Respiratory Mortality System
National Program of Cancer Registries
National Spina Bifida Patient Registry
Administrative
National Assisted Reproductive Technology Surveillance System
National Electronic Injury Surveillance System—Occupational Supplement
National Healthcare Safety Network
National Hospital Care Survey
Multiple sources
Asthma Surveillance
Chronic Kidney Disease Surveillance System
National Diabetes Surveillance System
National Violent Death Reporting System

Evaluation

- surveillance and health monitoring systems in use 2010-2013
  - periodic or continuous
- variables/questions related to:
  - race
  - ethnicity
  - primary language
  - nativity

Evaluation

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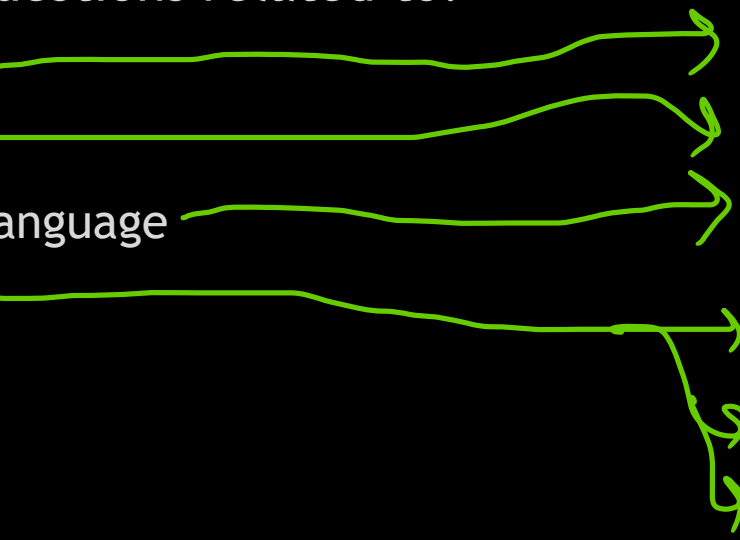

- minimum race data standards
- minimum ethnicity data standards
- preferred, spoken at home, interview, interpreter
- place of birth (US/non or specific)
- citizenship, refugee, immigration
- years in US

Variable	Total (n = 125) No. (%)	Type of Data System[a]				
		Case-Based (n = 54) No. (%)	Population Survey (n = 22) No. (%)	Registry (n = 16) No. (%)	Administrative (n = 16) No. (%)	Multiple Sources (n = 17) No. (%)
Race						
Yes	100 (80)	37 (69)	21 (95)	14 (88)	13 (81)	15 (88)
Basic[b]	74 (59)	32 (59)	10 (45)	9 (56)	10 (63)	13 (76)
Detailed[c]	26 (21)	5 (9)	11 (50)	5 (31)	3 (19)	2 (12)
No	25 (20)	17 (31)	1 (5)	2 (13)	3 (19)	2 (12)
Ethnicity						
Yes	102 (82)	39 (72)	21 (95)	14 (88)	13 (81)	15 (88)
Basic[b]	75 (60)	37 (69)	7 (32)	8 (50)	10 (63)	13 (76)
Detailed[c]	27 (22)	2 (4)	14 (64)	6 (38)	3 (19)	2 (12)
No	23 (18)	15 (28)	1 (5)	2 (13)	3 (19)	2 (12)
Primary language						
Yes	13 (10)	1 (2)	10 (45)	2 (13)	0 (0)	0 (0)
No	112 (90)	53 (98)	12 (55)	14 (88)	16 (100)	17 (100)
Place of birth						
Yes	40 (32)	17 (31)	10 (45)	10 (63)	3 (19)	0 (0)
Basic[b]	9 (7)	0 (0)	4 (18)	3 (19)	2 (13)	0 (0)
Detailed[c]	31 (25)	17 (31)	6 (27)	7 (44)	1 (6)	0 (0)
No	85 (68)	37 (69)	12 (55)	6 (38)	13 (81)	17 (100)
Immigration status						
Yes	14 (11)	9 (17)	5 (23)	0 (0)	0 (0)	0 (0)
No	111 (89)	45 (83)	17 (77)	16 (100)	16 (100)	17 (100)
Years in the United States						
Yes	21 (17)	11 (20)	10 (45)	0 (0)	0 (0)	0 (0)
No	104 (83)	43 (80)	12 (55)	16 (100)	16 (100)	17 (100)

Variable	Total (n = 125) No. (%)	Type of Data System[a]				
		Case-Based (n = 54) No. (%)	Population Survey (n = 22) No. (%)	Registry (n = 16) No. (%)	Administrative (n = 16) No. (%)	Multiple Sources (n = 17) No. (%)
Parental race or ethnicity						
Yes	6 (5)	2 (4)	0 (0)	2 (13)	0 (0)	2 (12)
No	119 (95)	52 (96)	22 (100)	14 (88)	16 (100)	15 (88)
Parental language						
Yes	4 (3)	1 (2)	3 (14)	0 (0)	0 (0)	0 (0)
No	121 (97)	53 (98)	19 (86)	16 (100)	16 (100)	17 (100)
Parental country of birth						
Yes	14 (11)	7 (13)	6 (27)	1 (6)	0 (0)	0 (0)
Basic[d]	6 (5)	1 (2)	5 (23)	0 (0)	0 (0)	0 (0)
Detailed[e]	8 (6)	6 (11)	1 (5)	1 (6)	0 (0)	0 (0)
No	111 (89)	47 (87)	16 (73)	15 (94)	16 (100)	17 (100)
Parental immigration status						
Yes	1 (1)	0 (0)	1 (5)	0 (0)	0 (0)	0 (0)
No	124 (99)	54 (100)	21 (95)	16 (100)	16 (100)	17 (100)
Parental years in the United States						
Yes	9 (7)	4 (7)	4 (18)	1 (6)	0 (0)	0 (0)
No	116 (93)	50 (93)	18 (82)	15 (94)	16 (100)	17 (100)

Evaluation

- Few data collection systems have adapted to capture appropriate data on diversity
- Gaps in data collection
  - race/ethnicity: 80%
  - primary language: 10%
  - nativity: 11—32%

Evaluation

- Lack of standardization across all systems
  - question/standard may be based on historic versions for comparability
- Most data collection forms only available in English
- Recommendations:
  - use of questions validated by Census Bureau
  - translation of collection forms, use of bilingual interviewers

Workshop Schedule

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