Public Health Surveillance Methods

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Objectives

- Discuss the methods used to conduct surveillance

- Review examples of surveillance methods

Post Questions in the Chat!

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

Workshop Schedule

Time	Topics
2:00—2:30 pm	Surveillance Approaches & Attributes
2:30—3:10 pm	Examples of Surveillance in Use
3:10—3:20 pm	Break
3:20—4:00 pm	Data Exploration in R

Common Surveillance Methods & Attributes

Surveillance Methods

Active Surveillance

- Health agencies contact health providers seeking reports

- Difficult for long periods and expensive

- Ensures more complete reporting of conditions

- Used in conjunction with specific epidemiologic investigation

Passive Surveillance

- Diseases are reported by healthcare providers

- Simple and inexpensive

- Limited by incompleteness of reporting and variability of quality

- Ideal for tracking common diseases over time

Additional Surveillance Methods

Sentinel Surveillance	Syndromic Surveillance

Sentinel Surveillance

- Reporting of health events by health professionals who are selected to represent a geographic area or a specific reporting group

- Can be active or passive

- Used to monitor common diseases

Syndromic Surveillance

- Focuses on one or more symptoms rather than a physician-diagnosed or laboratory-confirmed disease
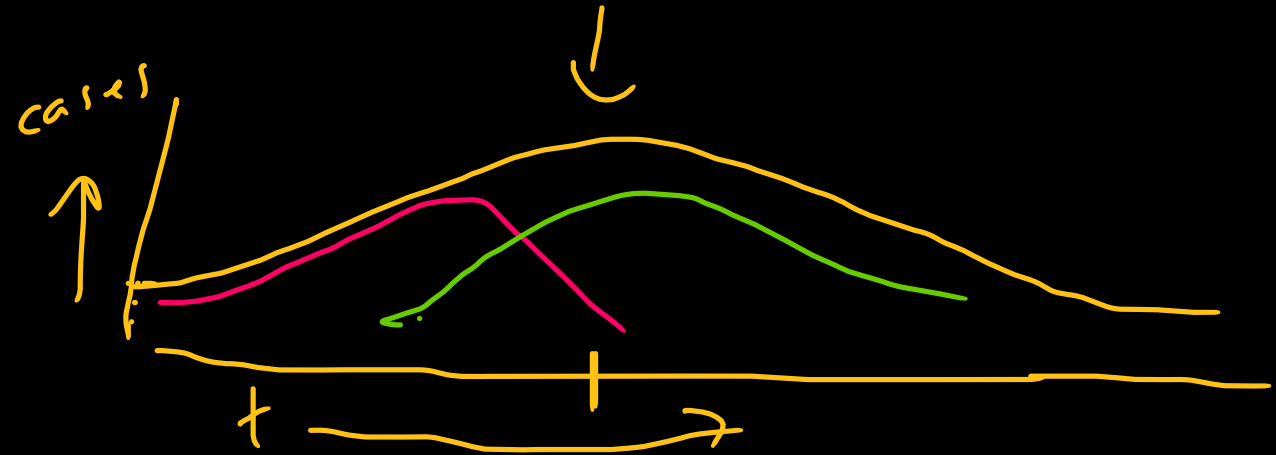
Additional Surveillance Methods

Determinant Surveillance

- Surveys or other data collection to identify risk factors

- Measures of environmental or social exposures contributing to health

Event-based Monitoring

- Enhanced investigation to provide intelligence on risky situations or emerging threats

Additional Surveillance Methods

Program Monitoring

- Vaccine uptake

- Screening programs

Attributes of Surveillance Systems

Usefulness
- How useful is the system in accomplishing its objectives?

Data quality
- How reliable are the available data?
- How complete/accurate are data fields in the reports received by the system?

Timeliness
- How quickly are reports received?

Attributes of Surveillance Systems

Flexibility
- How quickly can the system adapt to changes?

Simplicity
- How easy is the system's operation?

Stability
- Does the surveillance system work well?
- Does it break down often?

Attributes of Surveillance Systems

Sensitivity
- How well does it capture the intended cases?

Positive predictive value
- How many of the reported cases meet the case definition?

Representative-ness
- How good is the system at representing the population under surveillance?

Acceptability
- How easy is the system's operation?

Surveillance Process

Steps for Complete Surveillance

Surveillance Process

```
┌─────────────────────┐
│   Data Collection   │
└─────────────────────┘
          │
┌─────────────────────┐
│    Data Analysis    │
└─────────────────────┘
          │
┌─────────────────────┐
│        Data         │
│   Interpretation    │
└─────────────────────┘
          │
┌─────────────────────┐
│        Data         │
│    Dissemination    │
└─────────────────────┘
          │
┌─────────────────────┐
│    Link to Action   │
└─────────────────────┘
```

- Before collecting data, decide on the overarching goal of the system

Data Sources for Public Health Surveillance

- Reported diseases or syndromes
- Electronic health records (e.g., hospital discharge data)
- Vital records (e.g., birth and death certificates)
- Registries (e.g., cancer, immunization)
- Surveys (e.g., National Health and Nutrition Examination Survey [NHANES])
- Social media, searches on internet browsers
- Horizon scanning (e.g. WHO reports, ProMED)
- Healthcare-seeking behavior (e.g. ER use, telehealth calls)
- Accident/poisoning reporting
- Environmental hazards monitoring
- Meteorological data

- community-based reporting

emergeny phone

- media/news reports

- animal surveillance - bat (wild life)
- entomological "

=wastewater
=drinking

Nationally Notifiable Disease Surveillance System
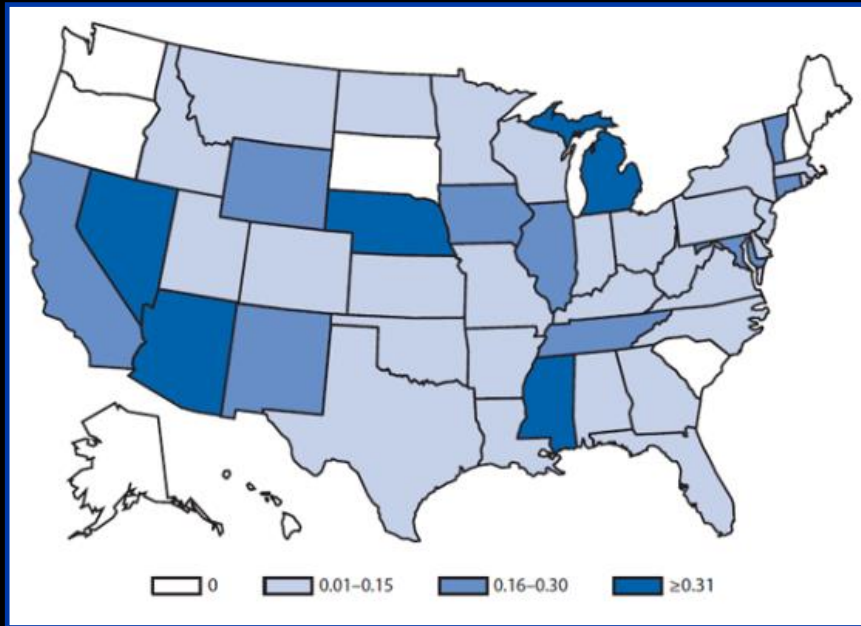
- Many disease on a state/province/regional list are also nationally notifiable

- statistics annually reported

Internationally Notifiable Diseases

- Reporting to WHO is required for cases of:
  - Smallpox
  - Poliomyelitis (wild type)
  - Human influenza caused by any new subtype
  - Severe acute respiratory syndrome (SARS)
- Other notifications may be required for certain diseases (e.g. cholera, viral hemorrhagic fever) or events that meet IHR criteria
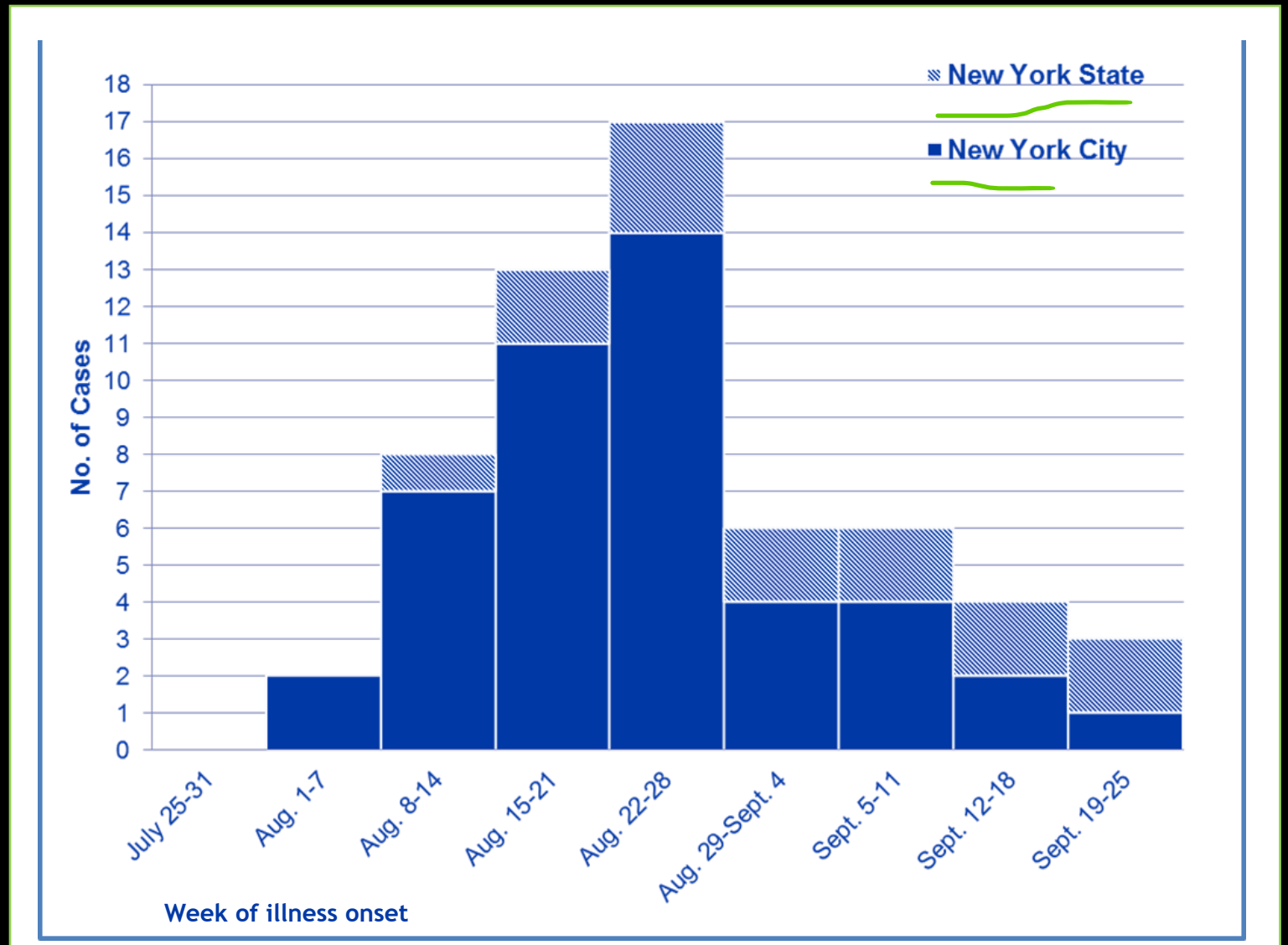
Surveillance Data Analysis

- Data Collection
- Data Analysis
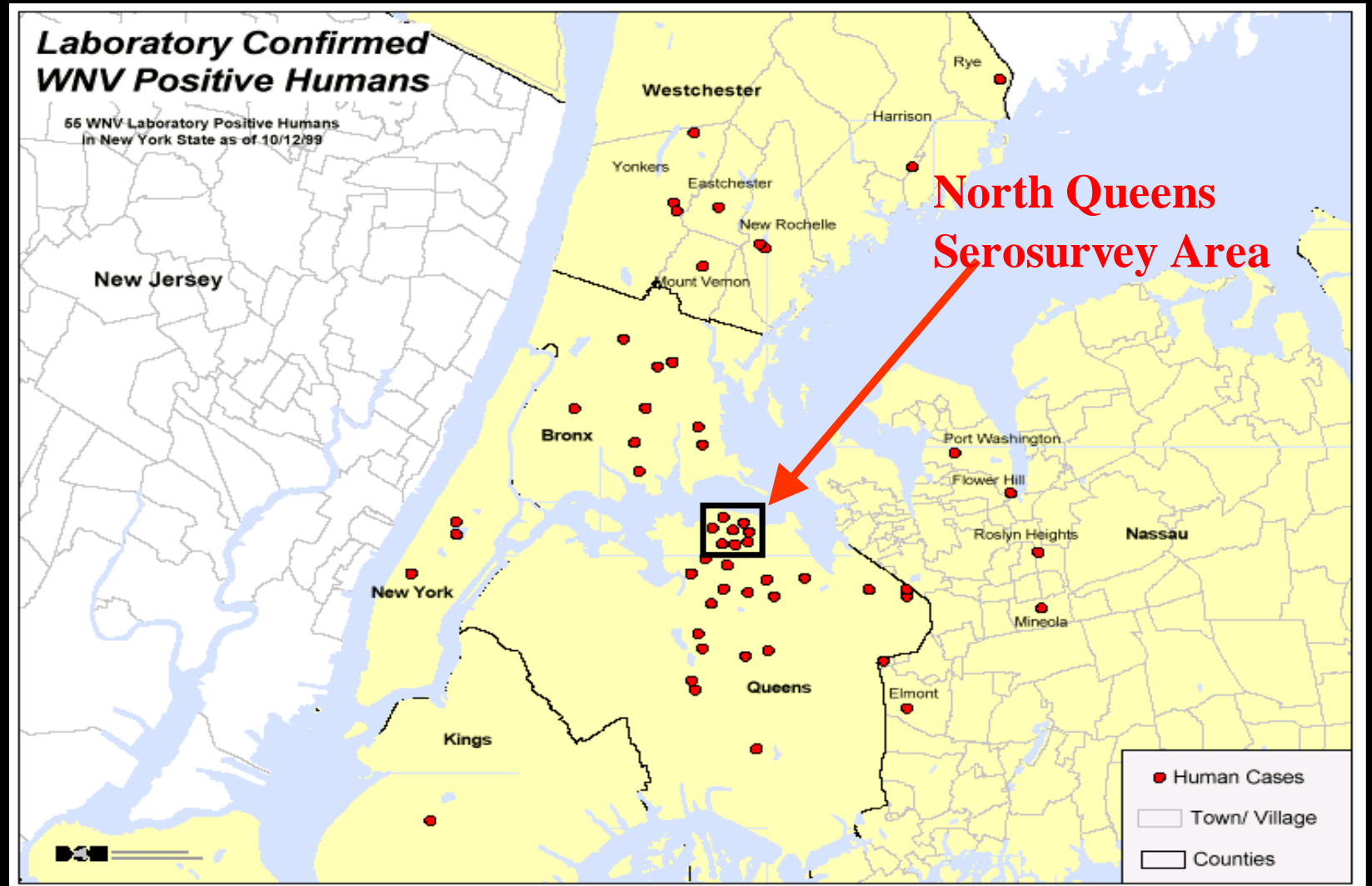- Data Interpretation
- Data Dissemination
- Link to Action
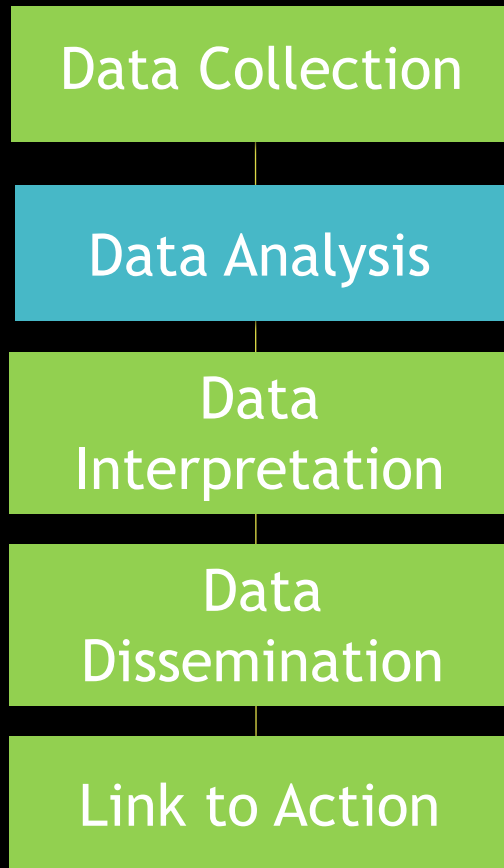
- Who will analyze the data?

- What methodology will they use?

- How often will they analyze the data?

Patients Hospitalized with WNV, Weekly, NY 1999

time

Nash D, Mostashari F, Fine A, et al. Outbreak of West Nile virus infection in the New York City area in 1999.
N Engl J Med. 2001;344:1807–14.

Surveillance Data Analysis by Place

Laboratory Confirmed WNV Positive Humans

55 WNV Laboratory Positive Humans in New York State as of 10/12/99

North Queens Serosurvey Area

Map Courtesy of the New York City Department of Health and Mental Hygiene

Surveillance Data Analysis by Person

Characteristic	No. of Patients (%)	Population at Risk	Rate of Infection per Million Population
Age (years)			
0-19	2 (3)	2,324,081	0.9
20-29	1 (2)	1,553,981	0.6
30-39	3 (5)	1,549,111	1.9
40-49	1 (2)	1,177,190	0.8
50-59	9 (15)	867,331	10.4
60-69	12 (22)	814,838	16.0
70-79	18 (31)	534,785	33.7
≥80	12 (20)	281,054	42.7
Age category (years)			
≥50	52 (88)	2,498,008	20.8
<50	7 (12)	6,604,363	1.1
Sex			
Male	31 (53)	4,289,988	7.2
Female	28 (47)	4,812,383	5.8
Race			
White	41 (69)	5,983,901	6.9
Nonwhite	9 (15)	3,118,470	2.9
Unknown	9 (15)	--	--
Borough or county of residence			
New York City			
Brooklyn (Kings)	3 (5)	2,300,664	1.3
Bronx	9 (15)	1,203,789	7.5
Manhattan	1 (2)	1,487,536	0.7
Queens	32 (54)	1,951,599	16.4
Staten Island (Richmond)	0	379,999	0.0
New York State			
Nassau	6 (10)	1,287,348	4.7
Westchester	8 (14)	847,866	9.1

Nash D, Mostashari F, Fine A, et al. Outbreak of West Nile virus infection in the New York City area in 1999. N Engl J Med. 2001;344:1807–14.

Surveillance Data Interpretation

Data Collection

Data Analysis

Data Interpretation

Data Dissemination

Link to Action
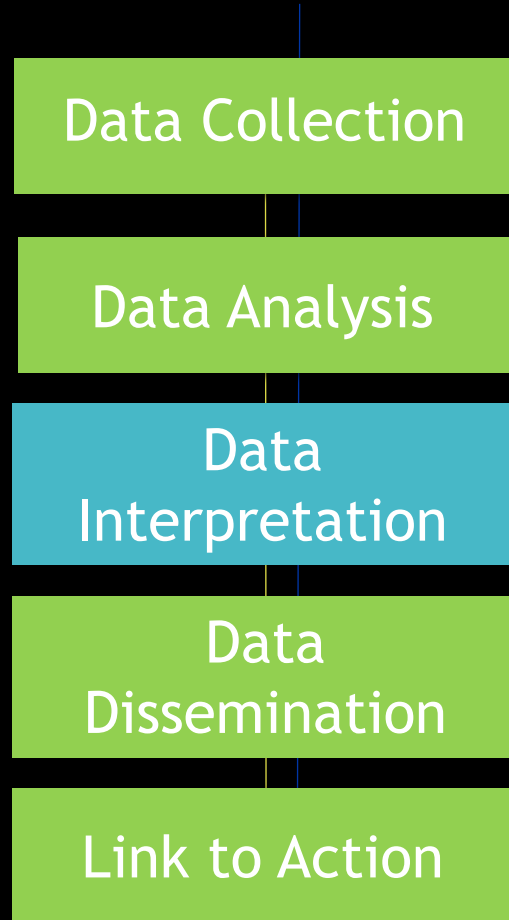
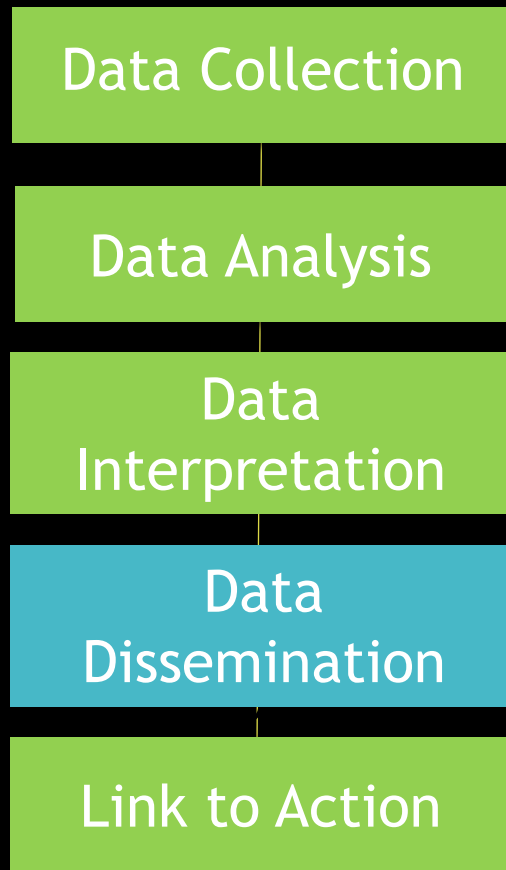- Data interpretation is closely coupled with data analysis

Number of Rare *E. Coli* Cases In U.S. Rose Last Year

By **WILLIAM NEUMAN**

Federal officials said on Tuesday that a national monitoring system for food-borne illness detected an increasing number of sicknesses last year from a group of rare E. coli bacteria related to the little-known and highly toxic strain that has been ravaging Germany.

For the first time, the group of rare E. coli strains was collectively identified as the cause of more illnesses in the United States than the more common form of the pathogen, probably because more laboratories have begun to test for their presence, said officials at the Centers for Disease Control and Prevention, which on Tuesday released 2010 results from its nationwide tracking system for food-borne diseases.

Neuman, W. Rare E. Coli Cases Rose In the U.S. Last Year. *New York Times* June 7, 2011. http://www.nytimes.com. Accessed July 9, 2014.

Data Dissemination

Data Collection

Data Analysis

Data Interpretation

Data Dissemination

Link to Action

- Health agency newsletters, bulletins, or alerts

- Surveillance summaries and reports

- Medical and epidemiologic journal articles

- Press releases and social media

Subsecretaria Nacional de Vigilancia de la Salud Pública
Dirección Nacional de Vigilancia Epidemiológica

ENFERMEDADES TRANSMITIDAS POR VECTORES
DENGUE. Ecuador, SE 20/ 2021

El dengue es una enfermedad producida por la picadura de mosquitos hembra de Aedes aegypti y Aedes albopictus infectados con el virus DENV. Puede ser mortal si no tiene un manejo clínico adecuado, especialmente cuando existe infección por diferentes serotipos. En la Región de Las Américas existen cuatro serotipos circulando (DENV-1, DENV-2, DENV-3 y DENV-4); durante el 2018 se notificaron en toda la región 560.586 casos, con una incidencia de 57,3 por cada 100.000 habitantes; de los cuales, 3.535 casos (0,63%) fueron clasificados como dengue grave. En Ecuador, durante el 2018 se notificaron 3.094 casos; En el 2019 8.416 caso de los cuales, 6.660 casos (79,13%) dengue sin signos de alarma (DSSA), 1718 casos (20,47%) fueron dengue con signos de alarma (DCSA) y 38 casos (0,49%) fueron dengue grave (DG).Entre la semana epidemiológica (SE) 1 y la SE 53 de 2020 en la Región de las Américas se notificaron 2.249.803 casos de dengue (incidencia de 230,46 casos por 100.000 habitantes), incluidas 983 defunciones. Del total de casos notificados, 987.765 (43,9%) fueron confirmados por criterio de laboratorio y 5.557 (0,25%) fueron clasificados como dengue grave. La tasa de letalidad fue 0,044%. Hasta la SE 20 del año 2021 se notifican 10.437 casos, de los serotipos DENV-1 y DENV-2.
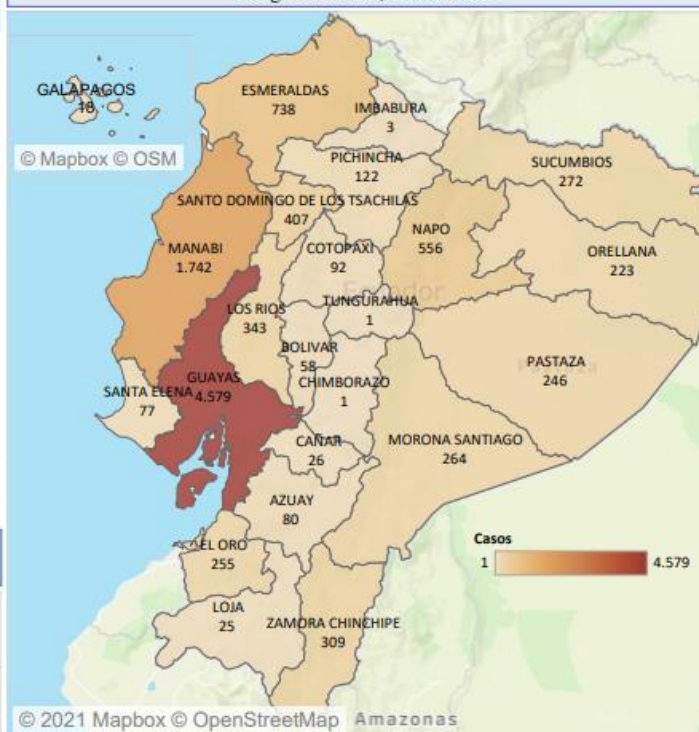
Número de casos confirmados de Dengue por provincia Ecuador, SE 20/2021

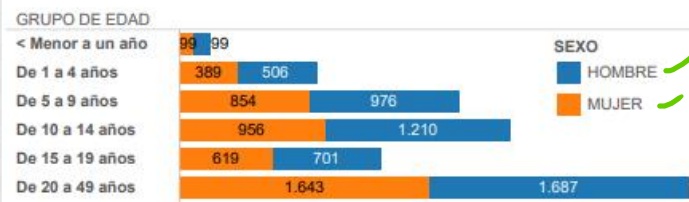| PROVINCIA	SE 01-19	SE 20	Total
GUAYAS	4.280	299	4.579
MANABI	1.668	74	1.742
ESMERALDAS	705	33	738
NAPO	528	28	556
SANTO DOMI..	387	20	407
LOS RIOS	332	11	343
ZAMORA CHI..	290	19	309
SUCUMBIOS	270	2	272
MORONA SA..	246	18	264
EL ORO	232	23	255
PASTAZA	238	8	246
ORELLANA	218	5	223
PICHINCHA	117	5	122
COTOPAXI	86	6	92
AZUAY	62	18	80
SANTA ELENA	63	14	77
BOLIVAR	58		58
CAÑAR	25	1	26
LOJA	24	1	25
GALAPAGOS	14	4	18
IMBABURA	3		3
TUNGURAHUA	1		1
CHIMBORAZO	1		1
Total	9.848	589	10.437

Número de casos confirmados de Dengue por provincia y tipo Ecuador, SE 20/2021

PROVINCIA	A90X Dengue sin complicacion..	A91X Dengue con signos de alarma	A91X Dengue grave	Total general
GUAYAS	4.167	393	19	4.579
MANABI	1.574	167	1	1.742
ESMERALDAS	718	20		738
NAPO	507	48	1	556
SANTO DOMINGO..	392	14	1	407
LOS RIOS	325	17	1	343
ZAMORA CHINCHI..	291	18		309
SUCUMBIOS	218	54		272
MORONA SANTIA..	260	4		264
EL ORO	224	31		255
PASTAZA	245	1		246
ORELLANA	212	11		223
PICHINCHA	112	10		122
COTOPAXI	89	3		92
AZUAY	77	2	1	80
SANTA ELENA	68	8	1	77
BOLIVAR	52	6		58
CAÑAR	26			26
LOJA	10	15		25
GALAPAGOS	18			18
IMBABURA	3			3

Dengue Ecuador, SE 20/ 2021

GALAPAGOS 18
ESMERALDAS 738
IMBABURA 3
PICHINCHA 122
SUCUMBIOS 272
SANTO DOMINGO DE LOS TSACHILAS 407
NAPO 556
MANABI 1.742
COTOPAXI 92
ORELLANA 223
TUNGURAHUA 1
LOS RIOS 343
BOLIVAR 58
GUAYAS 4.579
CHIMBORAZO 1
PASTAZA 246
SANTA ELENA 77
CAÑAR 26
MORONA SANTIAGO 264
AZUAY 80
EL ORO 255
LOJA 25
ZAMORA CHINCHIPE 309

© Mapbox © OSM
© 2021 Mapbox © OpenStreetMap   Amazonas

Casos: 1 — 4.579

Casos de Dengue por grupo de edad y sexo SE 20/2021

GRUPO DE EDAD		
< Menor a un año	99	99
De 1 a 4 años	389	506
De 5 a 9 años	854	976
De 10 a 14 años	956	1.210
De 15 a 19 años	619	701
De 20 a 49 años	1.643	1.687

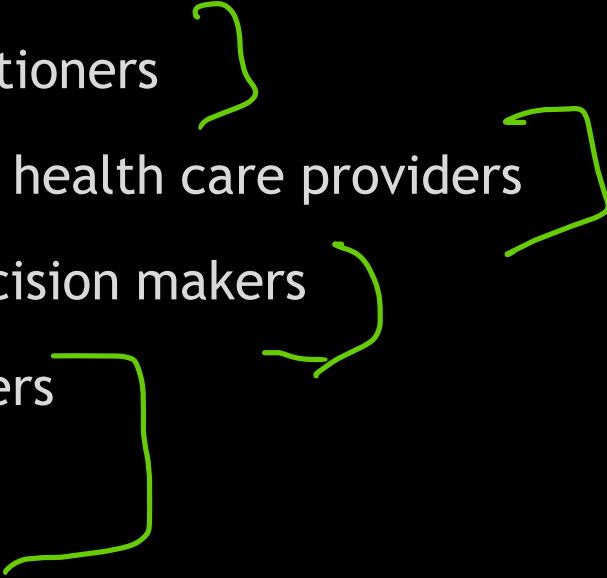SEXO: HOMBRE / MUJER

(handwritten annotations: time, place, person)

Data Dissemination and Target Audiences

- Public health practitioners

- Clinicians and other health care providers

- Policy and other decision makers

- Community organizers

- The general public
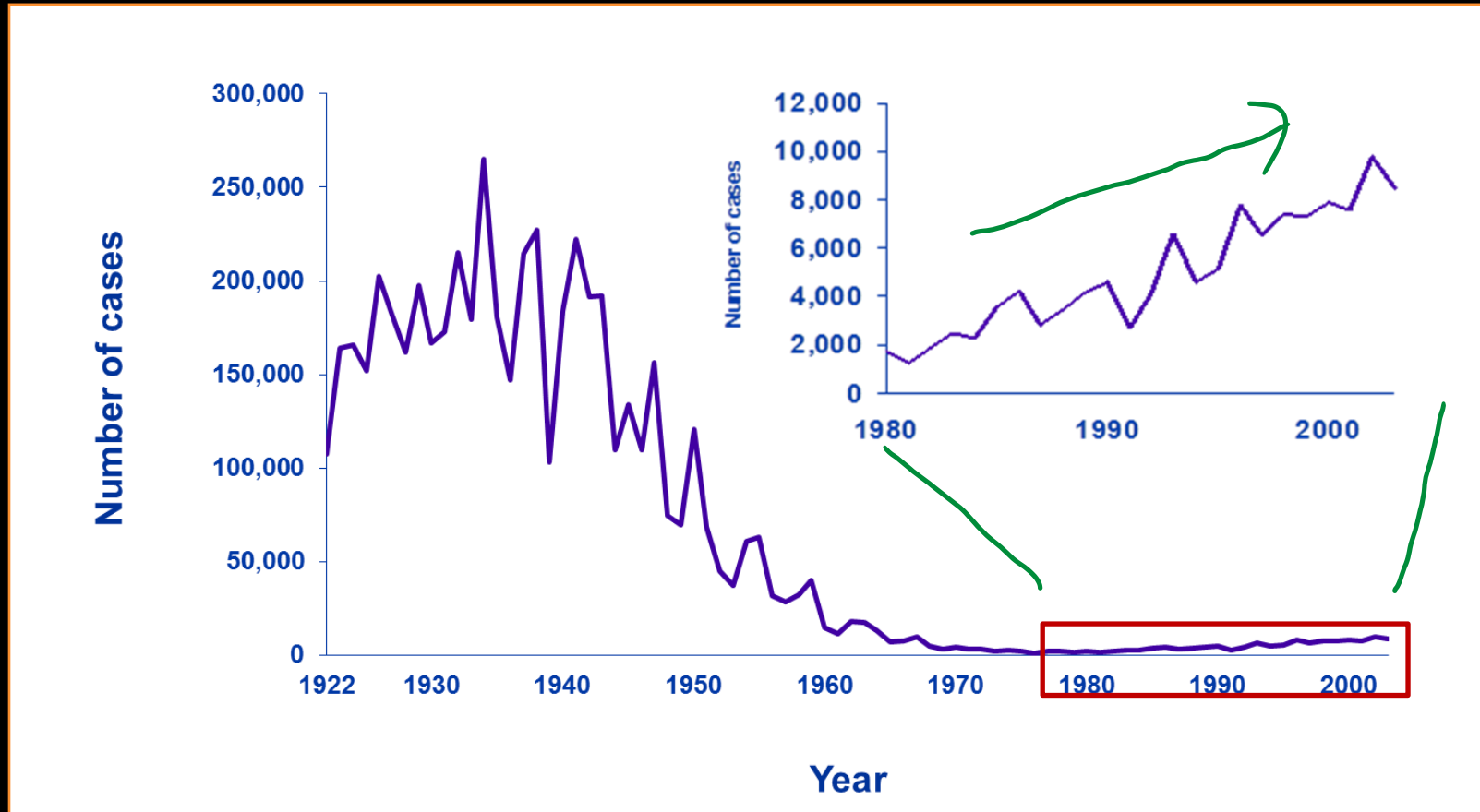
Surveillance Link to Action

Data Collection

Data Analysis

Data Interpretation

Data Dissemination

Link to Action

- Public health surveillance should always have a link to action

Link to Action

Pertussis (Whooping Cough) Cases, by Year — United States, 1922-2000
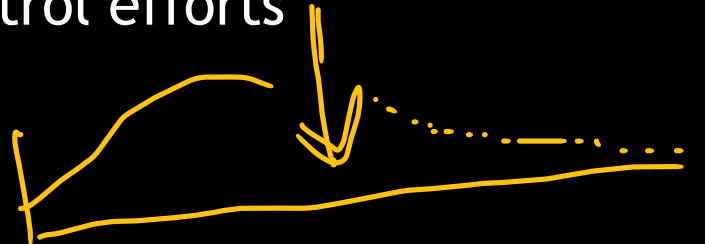
Surveillance-Based Action

summary reports

- Describe the burden of or potential for disease

- Monitor trends and patterns in disease, risk factors, and agents

- Detect sudden changes in disease occurrence and distribution

- Provide data for programs, policies, and priorities

- Evaluate prevention and control efforts

"The reason for collecting, analyzing, and disseminating information on a disease is to control that disease. Collection and analysis should not be allowed to consume resources if action does not follow."

—William Foege, 1976

Photo: Kay Hinton, Emory University

Foege WH, Hogan RC, Newton LH. Surveillance projects for selected diseases. Int J Epidemiol 1976;5:29–37.

Example Surveillance Programs

Behavioral Surveillance: BRFSS

- national telephone survey to collect data on risk behaviors, chronic health conditions, and use of preventive services

- collected by state but surveys are uniform across states to generate comparable data

- non-institutionalized adults on landlines and cell phones

- approximately 450,000 adults annually

- prison
- LTC
- homeless
- jailed

- people without phones

330 million

- people who don't answer phone

Behavioral Surveillance: BRFSS

- Calling all adults is not feasible!

- stratified random sampling approach

    - equal number of interviews per strata

    - over-sampling rural areas

- phone numbers randomly generated by a marketing company (disproportionate stratified sample)

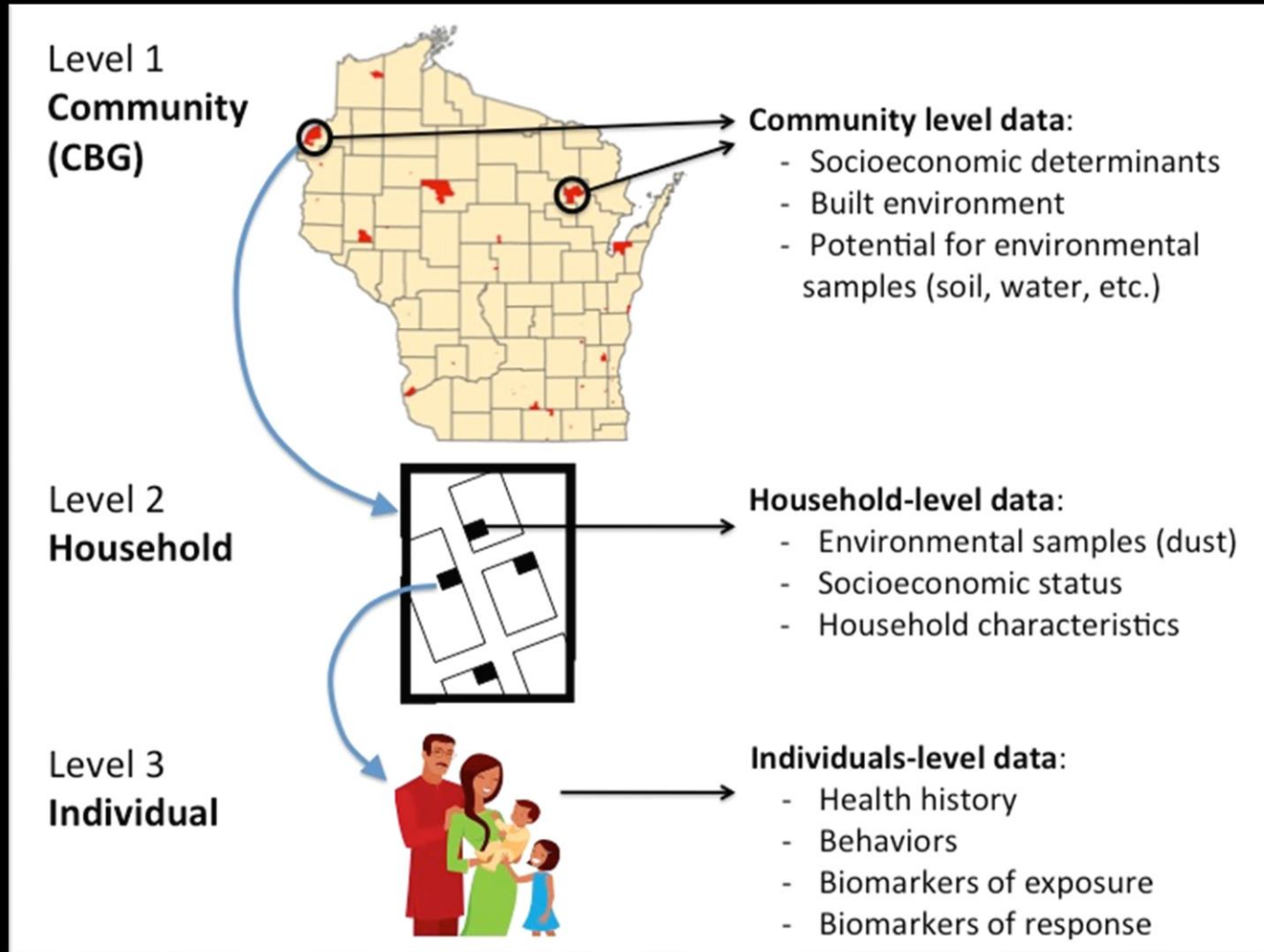*under represented populations*

Behavioral Surveillance: SHOW

- Only statewide **household-based examination survey** in the U.S.

- Modeled after CDC's National Health and Nutrition Examination Survey

- **Representative samples** of state residents; **Longitudinal follow-up** in 2017

- **Comprehensive annual surveys** since 2008 including **objective physical exam** and subjective interview data
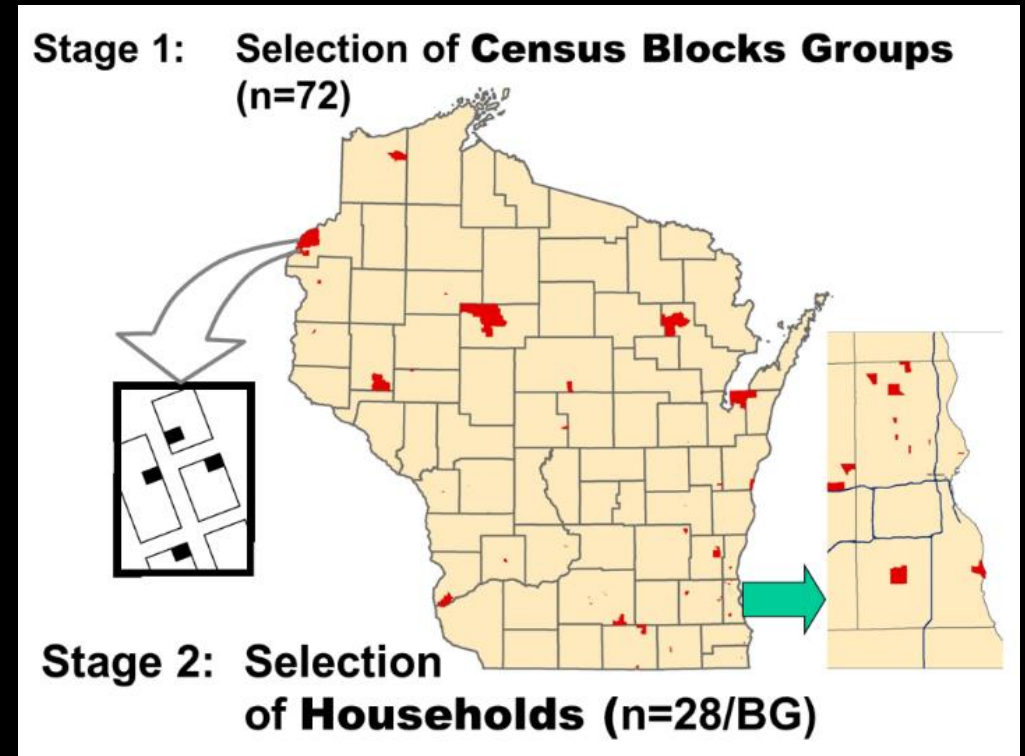
Behavioral Surveillance: SHOW

Multi-level data/sample collection strategy

Level 1 Community (CBG)

Community level data:
- Socioeconomic determinants
- Built environment
- Potential for environmental samples (soil, water, etc.)

Level 2 Household

Household-level data:
- Environmental samples (dust)
- Socioeconomic status
- Household characteristics

Level 3 Individual

Individuals-level data:
- Health history
- Behaviors
- Biomarkers of exposure
- Biomarkers of response

Behavioral Surveillance: SHOW

- Independent annual representative samples of state residents and communities

- Two-stage cluster sampling (CBG, household)

- Recruit persons 21-74 years of age

- 3,381 participants 2008-2013

Stage 1: Selection of **Census Blocks Groups** (n=72)

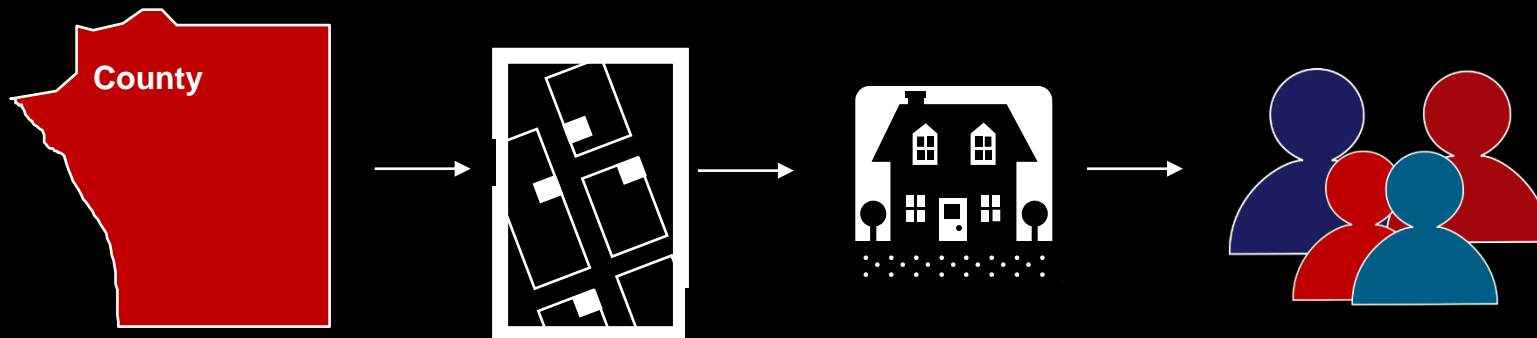Stage 2: Selection of **Households** (n=28/BG)

SHOW Survey Methods

Prior to household visit

- Selected households receive advance letter

At the door recruitment (2008 – 2017)

- Trained field staff explain study, complete household screening and enumeration
- All residents invited to participate
- Incentives for participation ($100-$200, t-shirt, tests results)

SHOW Survey Methods

- Goal: To reach underrepresented and hard-to-reach communities

- Approach: Event-based recruitment

- Attended over 40 community-based events throughout Milwaukee area

- Volunteers submit interest cards

- Field staff follow up and screen for eligibility
  - Incentives same as house-hold recruitment

SHOW Survey Methods

<u>In-home visit</u>
- Informed consent
- CAPI (computer assisted personal interview)*
- A-CASI (audio computer assisted self interview)*
- Physical measurements

<u>Self-administered, post in-home visit</u>
- Actigraphy: 7-day measurement of physical activity and sleep
- Pen and paper questionnaires
- Returned by mail

*In collaboration with the UW Survey Center

SHOW Survey Methods

<u>Biological sample collection visit</u>

- Collection by trained phlebotomists

- Blood by venipuncture; urine

- Stool, saliva, and oral, nasal and skin swabs for microbiome analysis*

- Immediate analysis for blood cell count, hemoglobin, platelet count, hemoglobin A1C, glucose, creatinine, total and HDL cholesterol and triglycerides

- Serum, plasma, urine, stool and DNA samples stored in biorepository for future unspecified research

SHOW Survey Methods

- Demographics and occupational history

- Housing characteristics, neighborhood characteristics, sense of community

- Health history, mental health, PTSD

- Prescription and OTC medications

- Health screening and immunization history

- Sensory and dental health

- Diet, food security

- Sleep, physical activity

- Health-related behaviors

- Cognitive function
- Health insurance, healthcare access, health literacy

SHOW Survey Methods

- Weight; height; waist, hip, and arm circumference

- Sitting blood pressure and pulse

- Spirometry (respiratory function)

- Sleep and physical activity by accelerometry (since 2014)

Surveillance Methods

- Different approaches capture common or rare health occurrences

- Using a combination of approaches is necessary to truly monitor population health

- Classical approaches can be supplemented with additional data sources for a more complete picture of the health of the population

Workshop Schedule

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