HEARTLAND
NATIONAL TB CENTER
A PARTNERSHIP OF UT HEALTH NORTHEAST AND TCID

Detecting and Handling a TB Outbreak

Leonard Mukasa, MBChB PhD

September 13, 2022

Little Rock, AR

Leonard Mukasa, MBChB, PhD has the following disclosures to make:

- No conflict of interests

- No relevant financial relationships with any commercial companies pertaining to this educational activity

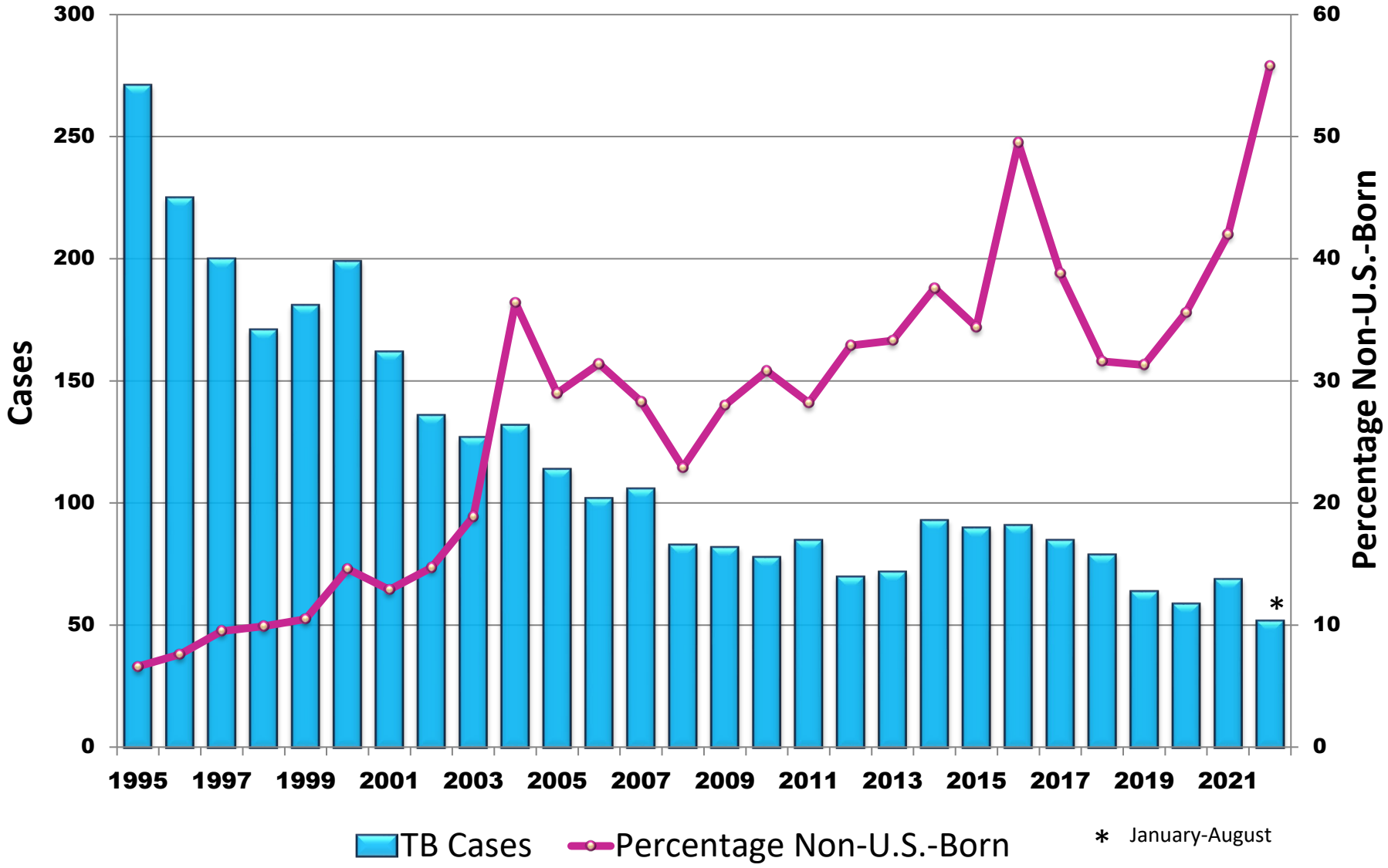
THINK
TEST
TREAT
TB

Objectives

1. Define a Large Outbreak of TB in the United States (LOTUS)

2. Why do TB outbreaks still occur ?

3. Where is the frontline for TB elimination?


Trends in TB Cases, Arkansas, 1995-2022*
Cases
Percentage Non-U.S.-Born
300
250
200
150
100
50
0
60
50
40
30
20
10
0
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
2017
2019
2021
*
TB Cases
Percentage Non-U.S.-Born
* January-August

What Is a Large Tuberculosis Outbreak?

CDC Definition: Large Outbreak of TB in the United States (LOTUS)

10 or more cases diagnosed within a 3-year period

US 2014-2016
24 large outbreaks that included 518 cases (median: 18.5 cases per outbreak)

How is outbreak determined?

Era TB Genotyping in Arkansas

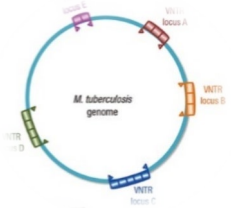
Whole Genome Sequencing

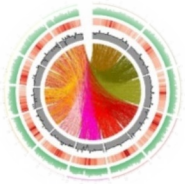
Era of TB Genotyping

Joseph Bates, MD
UAMS

Don Cave,
PhD
UAMS

Kathy Eisenach,
PhD
UAMS





1955-1991

Phagetyping, Advances in Biology Computing

1992-1995

Pioneering Genotyping Work in AR

1996-2003

National TB Genotyping & Surveillance Network;

7 Sentinel Sites

2004-2018

Spoligotyping & MIRU

~2% coverage

2018-2022

Whole Genome Sequencing (WGS)

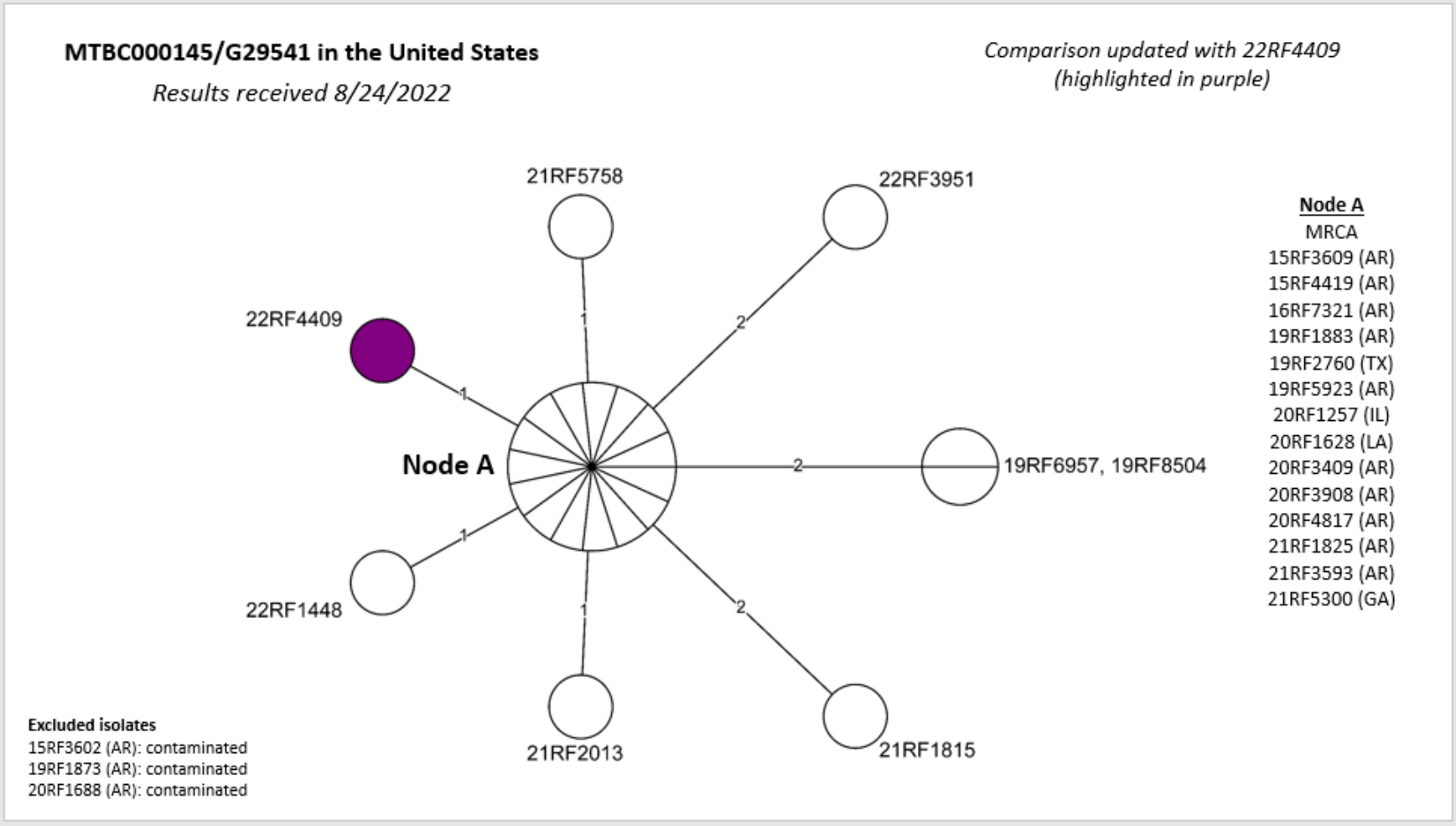
~98% coverage

Digital Report Cluster G29541, Based in Howard County

State Case Number	Date_ Specimen_ Collection	wgMLSType	GENType	State Cluster Name
2022ARGA2200000	01/13/2022	MTBC000145	G29541	AR_0049_003
2022ARAR2200009	02/08/2022	MTBC000145	G29541	AR_0049_003
2021ARAR2100061	08/20/2021	MTBC000145	G29541	AR_0049_003
2021ARAR2100034	05/26/2021	MTBC000145	G29541	AR_0049_003
2021ARAR2100034	06/07/2021	MTBC000145	G29541	AR_0049_003
2021ARAR2100019	02/22/2021	MTBC000145	G29541	AR_0049_003
2021ARAR2100005	12/31/2020	MTBC000145	G29541	AR_0049_003
2021ARAR2100001	01/20/2021	MTBC000145	G29541	AR_0049_003
2020ARAR2000032	06/25/2020	MTBC000145	G29541	AR_0049_003
2020ARAR2000021	05/07/2020	MTBC000145	G29541	AR_0049_003
2019ARAR1900052	09/03/2019	MTBC000145	G29541	AR_0049_003
2019ARAR1900044	08/26/2019	MTBC000145	G29541	AR_0049_003
2019ARAR1900040	07/24/2019	MTBC000145	G29541	AR_0049_003
2019ARAR1900040	07/09/2019	MTBC000145	G29541	AR_0049_003
2018ARAR1800080	01/04/2019	MTBC000145	G29541	AR_0049_003
2016ARAR1600063	09/21/2016		G29541	AR_0049_003
2015ARAR1500044	05/02/2015		G29541	AR_0049_003
2015ARAR1500038	03/19/2015		G29541	AR_0049_003

Whole Genome Sequencing

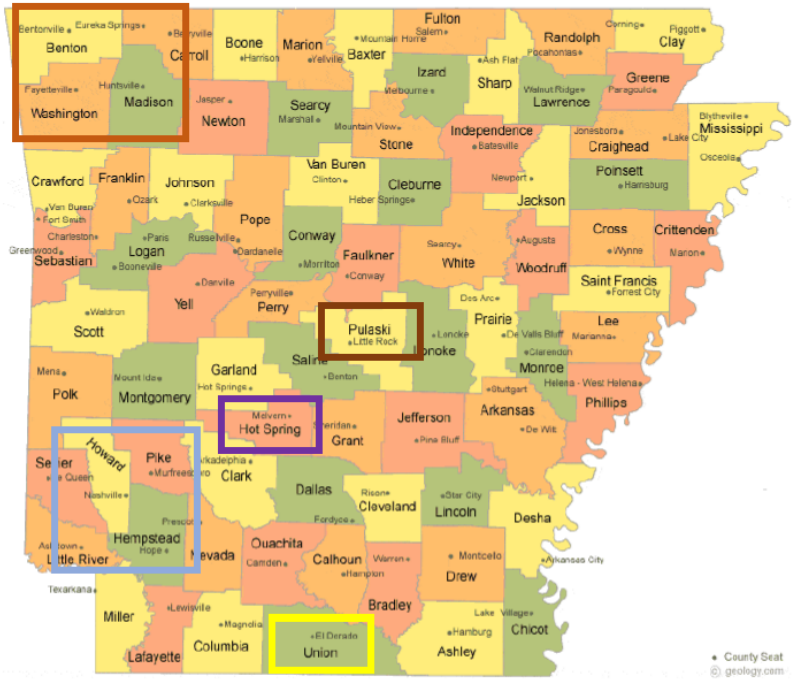
A SNP Analysis: Large Outbreak TB Among African Americans, Based in Howard County, Arkansas

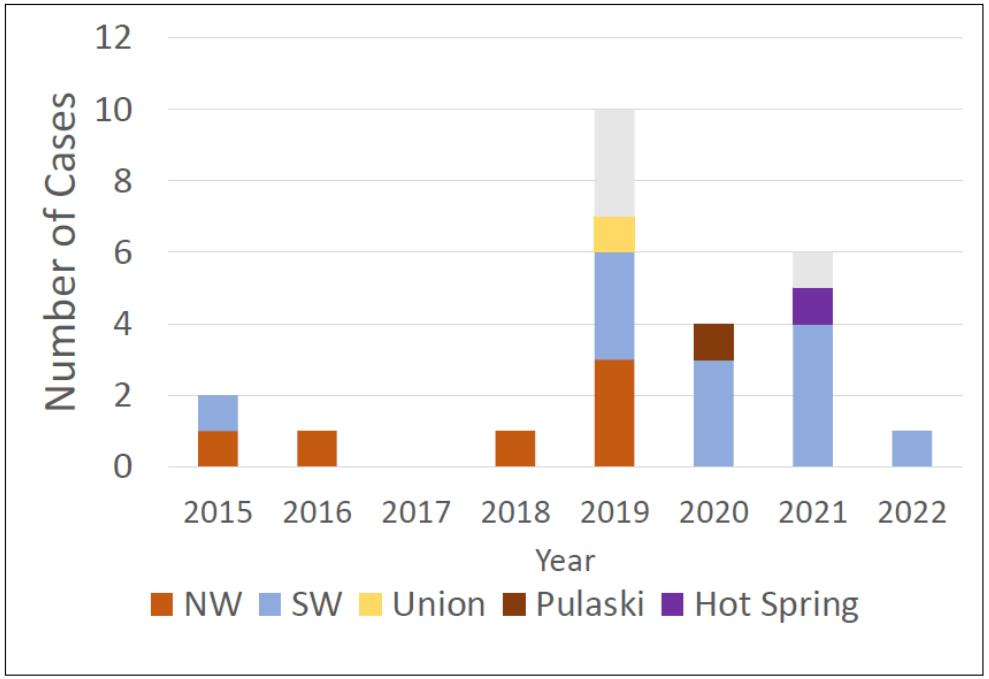


SNP: Single Nucleotide Polymorphism

Timeline, Outbreak Based in Howard County

Affected Counties in Arkansas

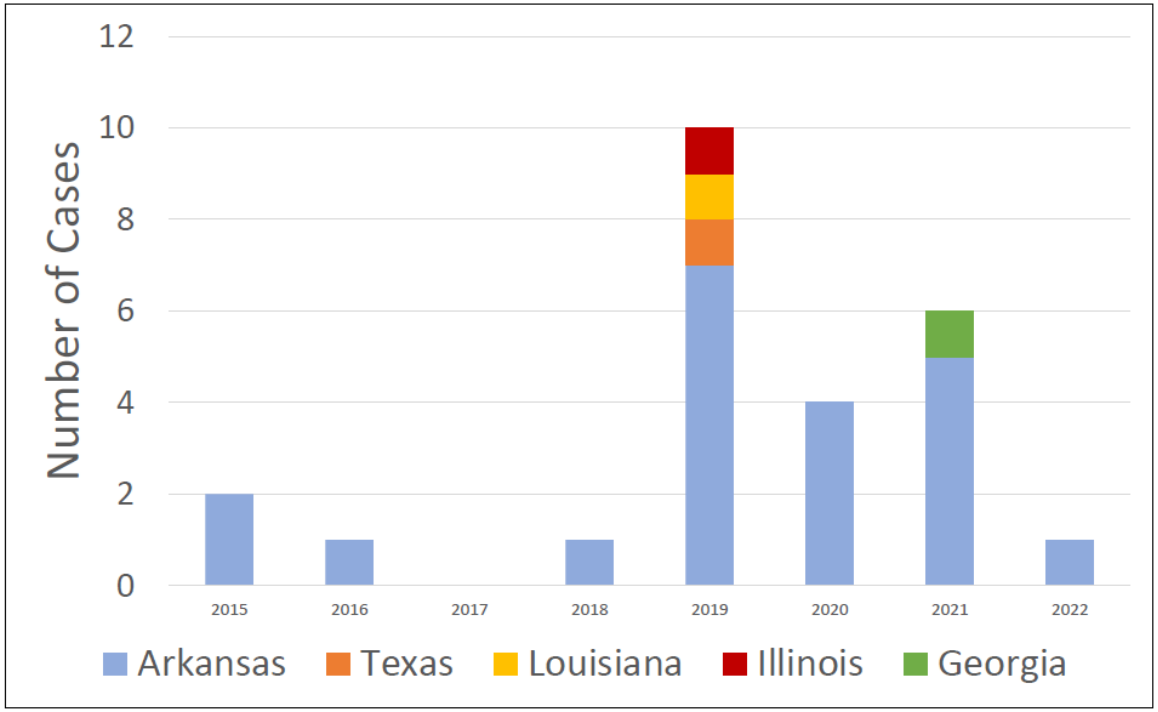




*Includes clinical cases

Epi-Aid Team, CDC

G29541 Cluster Epidemic Curve by State



Epi-Aid Team, CDC

Total Cases

Cases	N
Confirmed	21
Probable	6

Basic Demographic Characteristics

Characteristic	N (%)
Total	27
Male Sex	22 (81)
Median Age (Range)	27 (1–61)
Race/ethnicity	
Non-Hispanic, Black	22 (81)
Non-Hispanic, White	3 (11)
Hispanic	2 (8)

Epi-Aid, CDC

Basic Clinical Characteristics*

Characteristic	N (%)
Total	24
TB Risk Factor	4 (17)
Pulmonary disease	21 (88)
Cavitary disease	11 (52)**
Only extrapulmonary disease	3 (12)

*Data drawn from medical charts for 24 patients
**Among patients with pulmonary disease

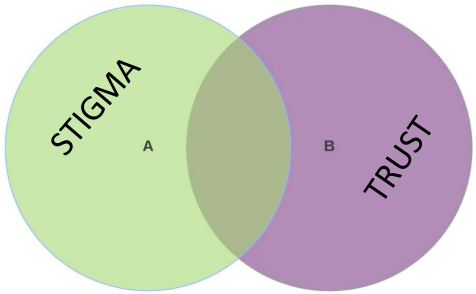
Epi-Aid, CDC

The Challenges

Delayed Diagnosis

Patient delay	Physician delay

Difficult contact investigations



Tuberculosis Transmission

What Causes TB in AR?
Causal Inference in TB Epidemiology

Arkansans  Tuberculosis Disease

Causal Graph for Tuberculosis

Names
Age
Sex
Race/Ethnicity
Country of Birth
Education
Zip Code
Co-morbidities
- *Diabetes*
- *HIV*
- *Cancer*

What have we done about this outbreak?

Southwest Region

Tiffany Landaal, CDNS

Howard County Health Unit
Wendi Williams, RN
Cheryl Haislip

Hempstead County Health Unit
Debbie Howard

Central Office TB Program Team

Naveen Patil, MD
Sandra Chai, MD
Atul Kothari, MD

TB Clinicians

Steven Dahl, MD
Pediatrics

Jenna Maturino, BSN RN

TB Program Nurses

Teresa Plummer, BSN RN
Pediatrics

Michelle Herndon
Dena Myers-Duhart

TB Registry
Administrative Tasks

Susan Cooley
Grants/Program Manager

Leonard Ntaate Mukasa
Chief Epidemiology Officer

- *Sabrina Nabinger, BA, CDC Public Health Associate*
- *Danielle Boothe, MPH, Doctoral Student Epidemiology*
- *Brian Delavan, MPH, Doctoral Student Bioinformatics*

Division of Tuberculosis Elimination, CDC

Epi-Aid Field Team

Dan Filardo
Theresa Dulski
Virginia Maturino
Sabrina Nabinger
Rebekah Stewart
Molly Duetsch-Feldman
Luc Marzano
Allison James

DTBE

Maryam Haddad
Clint McDaniel
Adam Langer
Jonathan Wortham
Gail Burns
Mark Miner

Summary Contact Investigation, 2015-2022

Contacts Identified	106	Percentage (%)
Contacts Evaluated	89	84.0
TB Cases	19	17.9
LTBI Cases	22	24.7
Completed Treatment LTBI	13	59.1
Ratio Contacts/TB Case	4 : 1	

Work in Progress: Community Partnerships

- ✓ Howard Memorial Hospital
- ✓ Tyson Plant, Nashville AR
- ✓ Pilgrim's Pride Plant, DeQueen AR
- ✓ Correctional Facilities
- ✓ Minority Health, ADH
- ✓ New Addition Community Outreach
- ✓ Office of Faith-based Outreach, ADH

- Schools
- County Judge
- County Sheriff

Detecting and Handling a TB Outbreak; DeQueen, Sevier County, 2017

Leonard Mukasa, MBChB PhD
Chief Epidemiology Officer|Tuberculosis

September 7, 2017

Outline

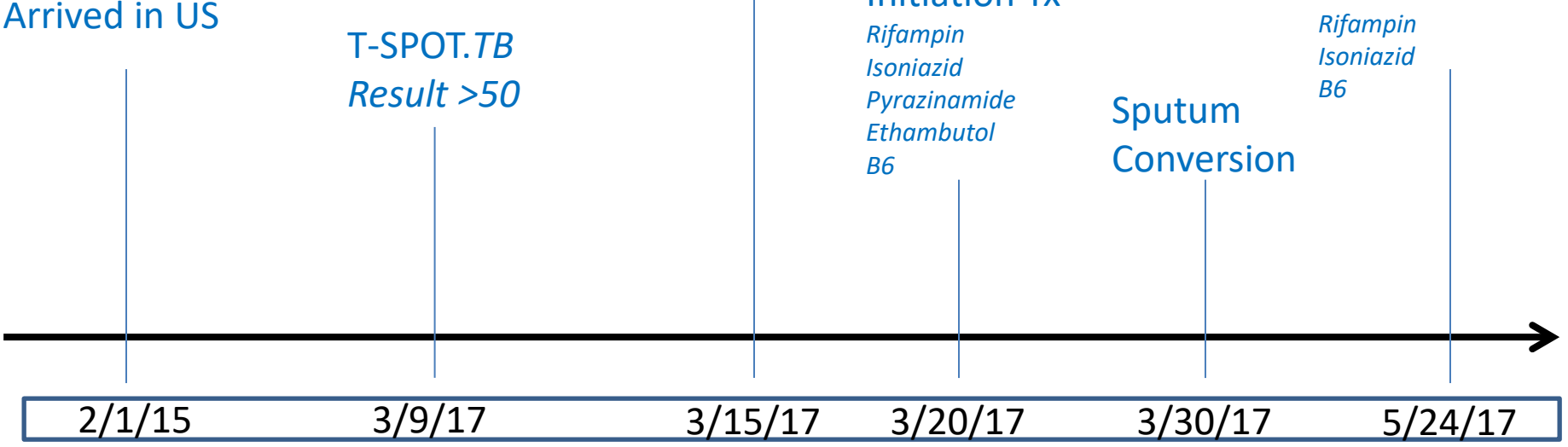
- The Source Case
- Secondary Cases
- Response to Outbreak
  - ✓TB Case Manager Southwest Region
  - ✓TB Control Program
  - ✓Center for Local Public Health
  - ✓ADH Leadership
- Epidemiologic Context| TB Among Marshallese
- Arkansas's Mini-Marshall Plan

Source Case

56 year old Marshallese male
Diabetes Mellitus

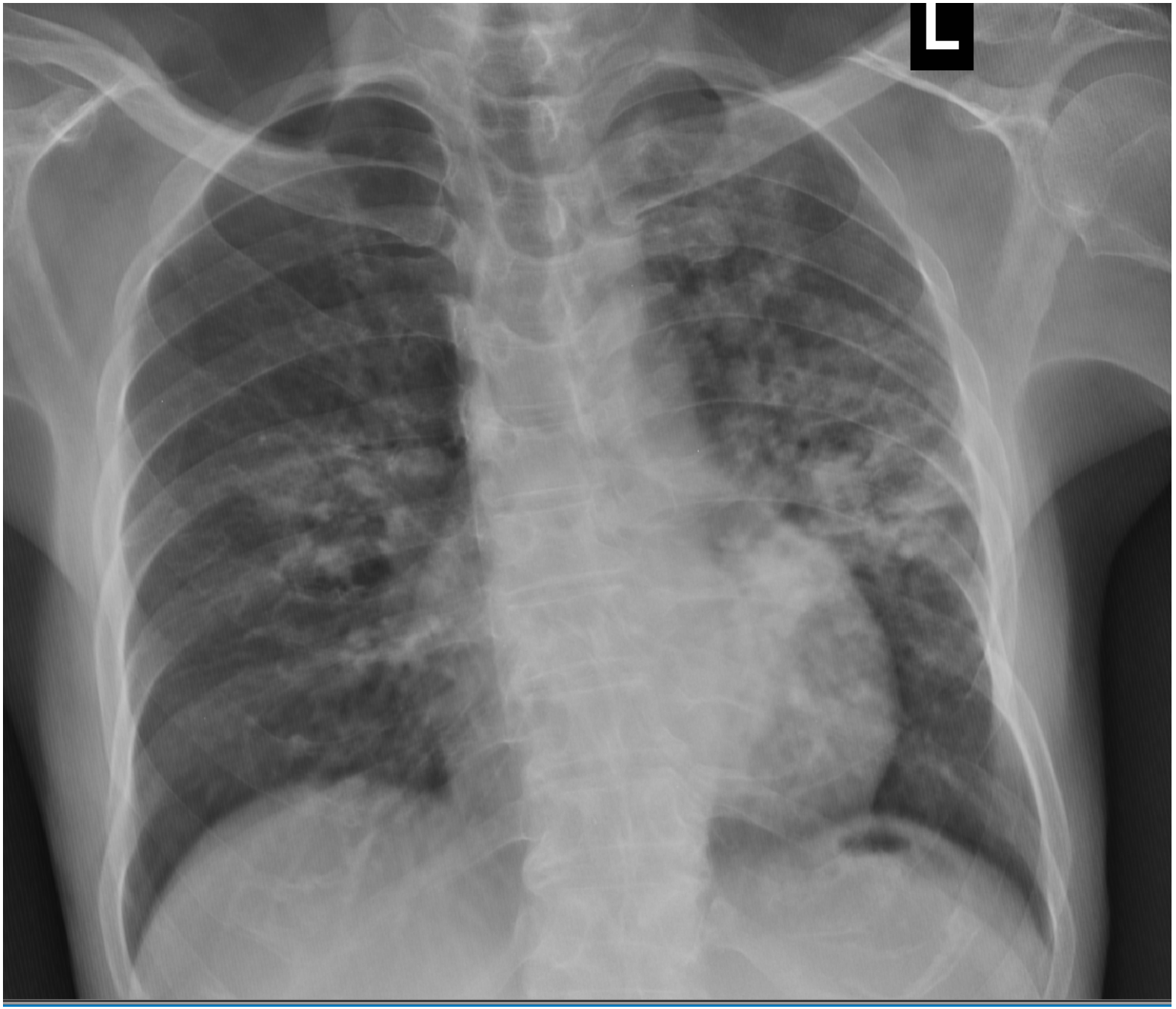
Productive cough
Hemoptysis
Night sweats
Weight loss; 97lb

CXR
Bilateral infiltrates
Possible cavitation
Sputum
AFB smear +
GeneXpert + M.tb

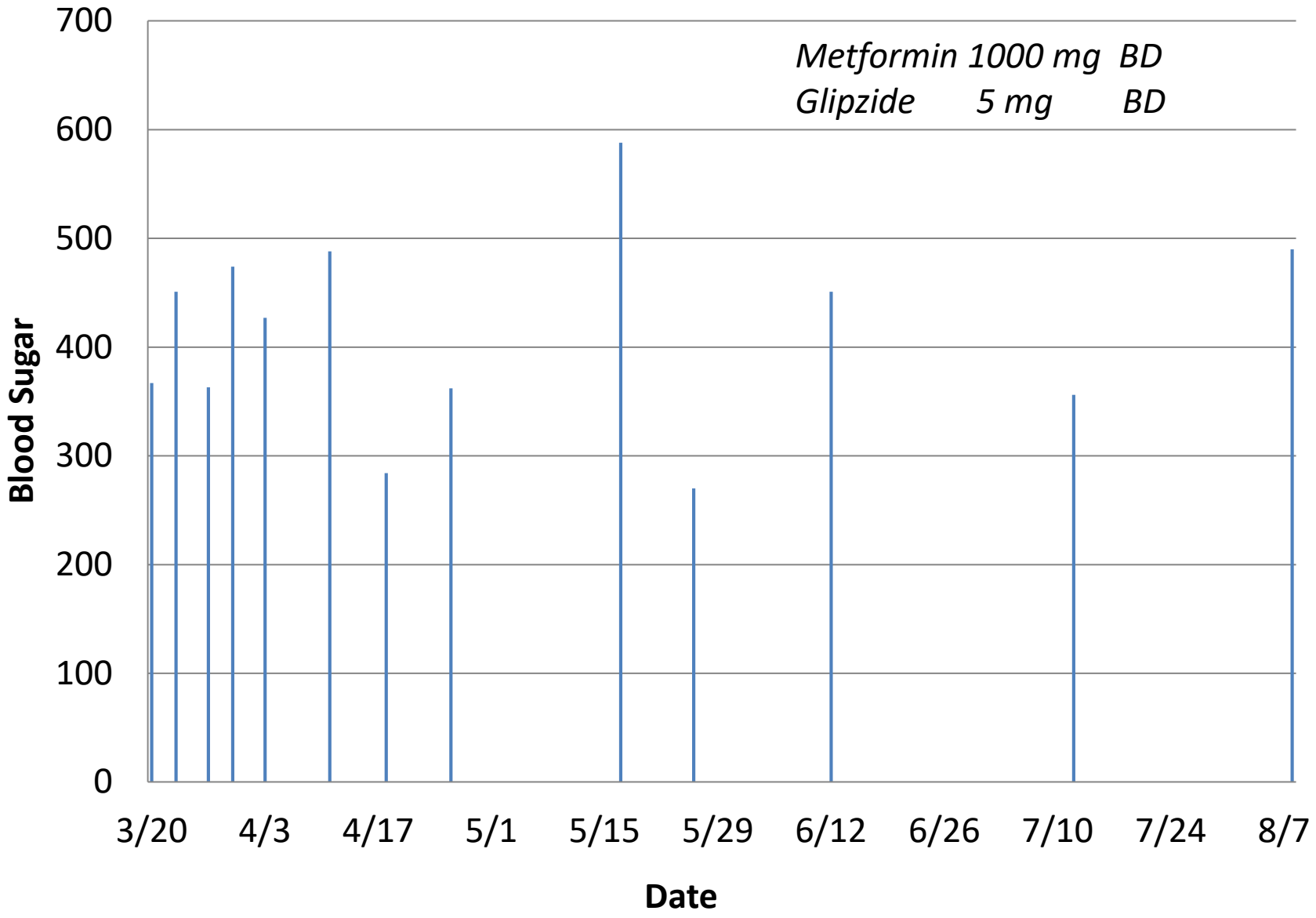


Source Case

March 15 2017



Source Case; Poor Blood Sugar Control



22 Moths Old

- Cough
- Wheeze

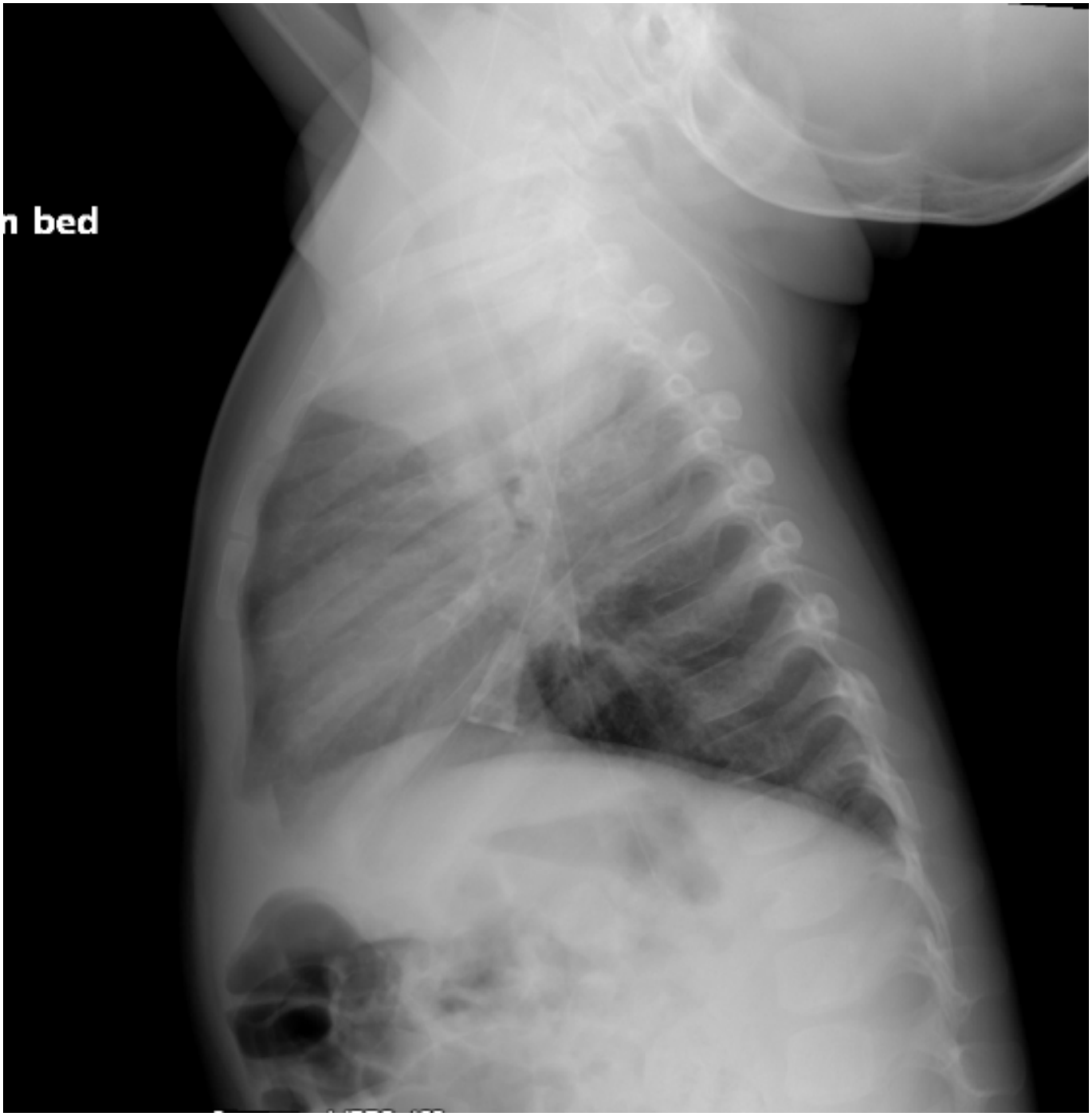
TST = 36mm

CXR:April 18 2017

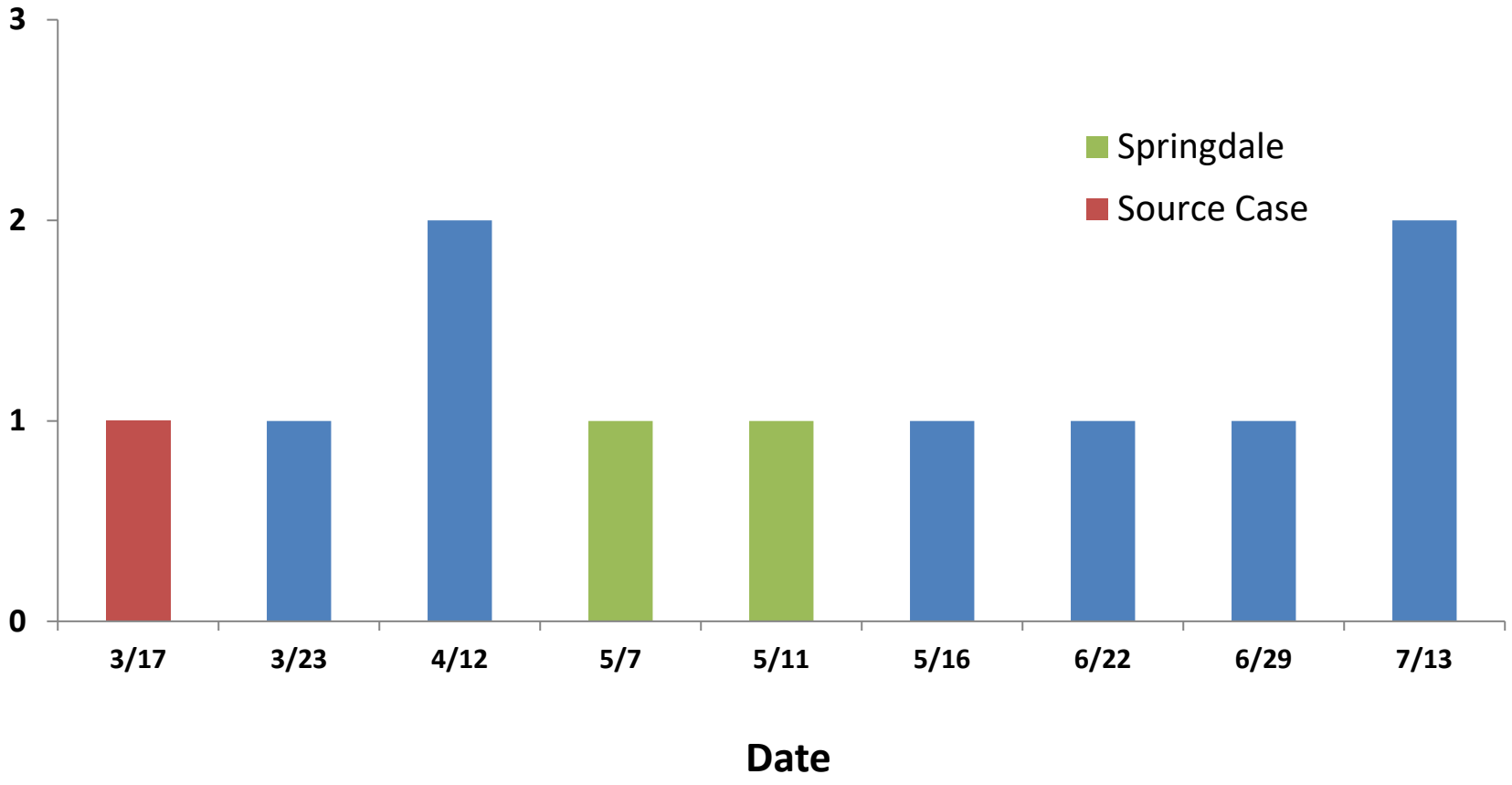
- *LUL consolidation*
- *Adenopathy*
  - *Mediastinal*
  - *Hilar*

Gastric aspirates negative

CST normal


n bed

TB Outbreak Among Marshallese, DeQueen, Sevier County, AR 2017, (N = 11)



Select Characteristics of TB Cases Among Marshallese, AR, 2017

COUNT_DATE	BIRTH_COUNTRY	ARRIVED_IN_US	AGE	TST_MM/T.SPOT	CASE_VERIFICATION	COUNTY
7/7/2017	MARSHALL ISLANDS	6/1/2016	32		1 - Positive Culture	Carroll
7/27/2017	UNITED STATES		9	T.SPOT =25	3 - Clinical Case Definition	Carroll
1/24/2017	MARSHALL ISLANDS	1/1/2010	26	30	1 - Positive Culture	Randolph
3/17/2017	MARSHALL ISLANDS	2/1/2015	56	T.SPOT>50	1 - Positive Culture	Sevier
4/13/2017	UNITED STATES		12	50	3 - Clinical Case Definition	Sevier
5/4/2017	UNITED STATES		1	36	3 - Clinical Case Definition	Sevier
5/4/2017	UNITED STATES		3	34	3 - Clinical Case Definition	Sevier
6/15/2017	UNITED STATES		13	20	3 - Clinical Case Definition	Sevier
6/22/2017	UNITED STATES		8	T.SPOT >50	3 - Clinical Case Definition	Sevier
7/3/2017	UNITED STATES		4	39	3 - Clinical Case Definition	Sevier
7/20/2017	UNITED STATES		8	50	3 - Clinical Case Definition	Sevier
7/13/2017	UNITED STATES		6	37	3 - Clinical Case Definition	Sevier
2/17/2017	MARSHALL ISLANDS	9/1/2016	50		1 - Positive Culture	Washington
7/3/2017	MARSHALL ISLANDS	3/18/2015	30		1A - Positive NAA	Washington
7/24/2017	MARSHALL ISLANDS	1/1/2013	10	T.SPOT >50	3 - Clinical Case Definition	Washington
5/7/2017	UNITED STATES		2	QFT >10.0	3 - Clinical Case Definition	Washington
5/11/2017	UNITED STATES		1	0/0	4 - Verified by Provider Diagnosis*	Washington

* Right middle lobe infiltrate

Responding to the Outbreak

- **Jan Dougan, TB Case Manager Southwest Region**
- **Sandy Hainline, Bates Outreach Clinic, Springdale**
- **Two new Marshallese Translators (Outreach Workers)**

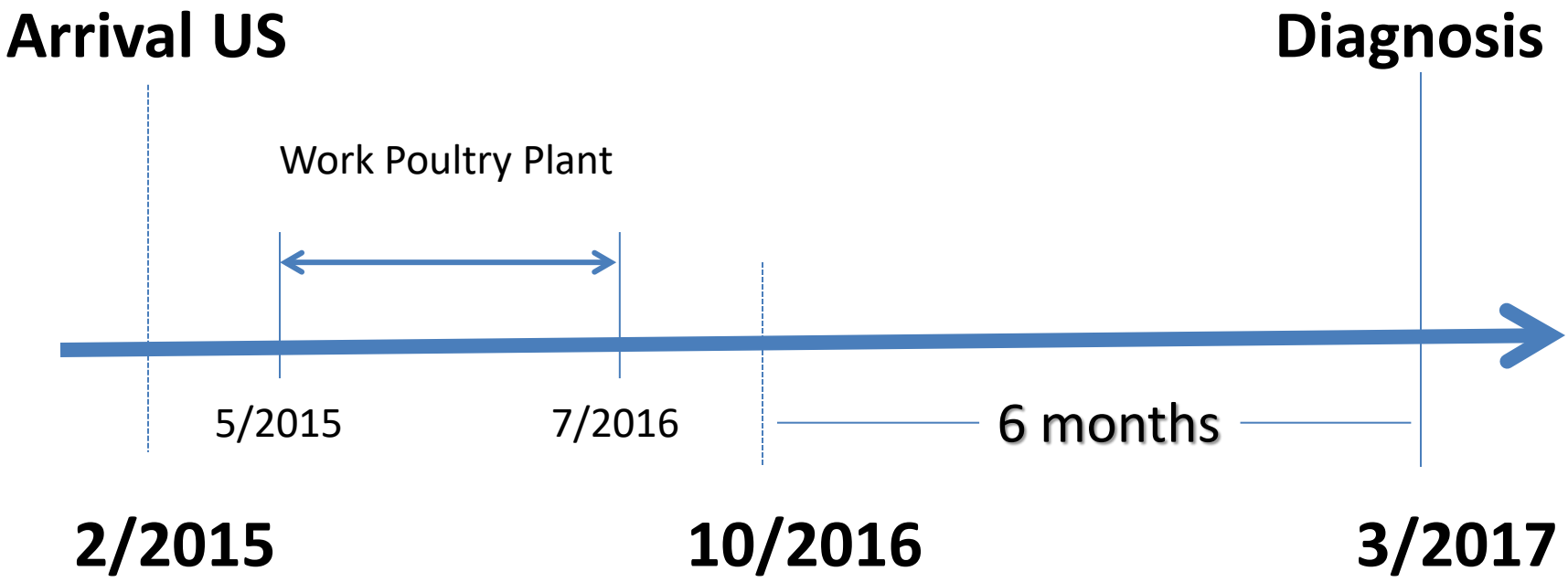
Results of Contact Investigation on Source Case, TB Outbreak, DeQueen, AR 2017

Age Group (years)	Persons Screened	Screening Status		
		Negative	Positive	Proportion(%)
< 5	23	19	4	17.4
5-18	71	54	17	23.9
19-34	52	33	19	36.5
35+	47	24	23	48.9
Total	193	130	63	32.6

- 10 of 10 secondary cases are under 14 years of age and were born in US
- 2 of 10 secondary cases located in Springdale
- 6 of 10 contacts in Springdale were infected

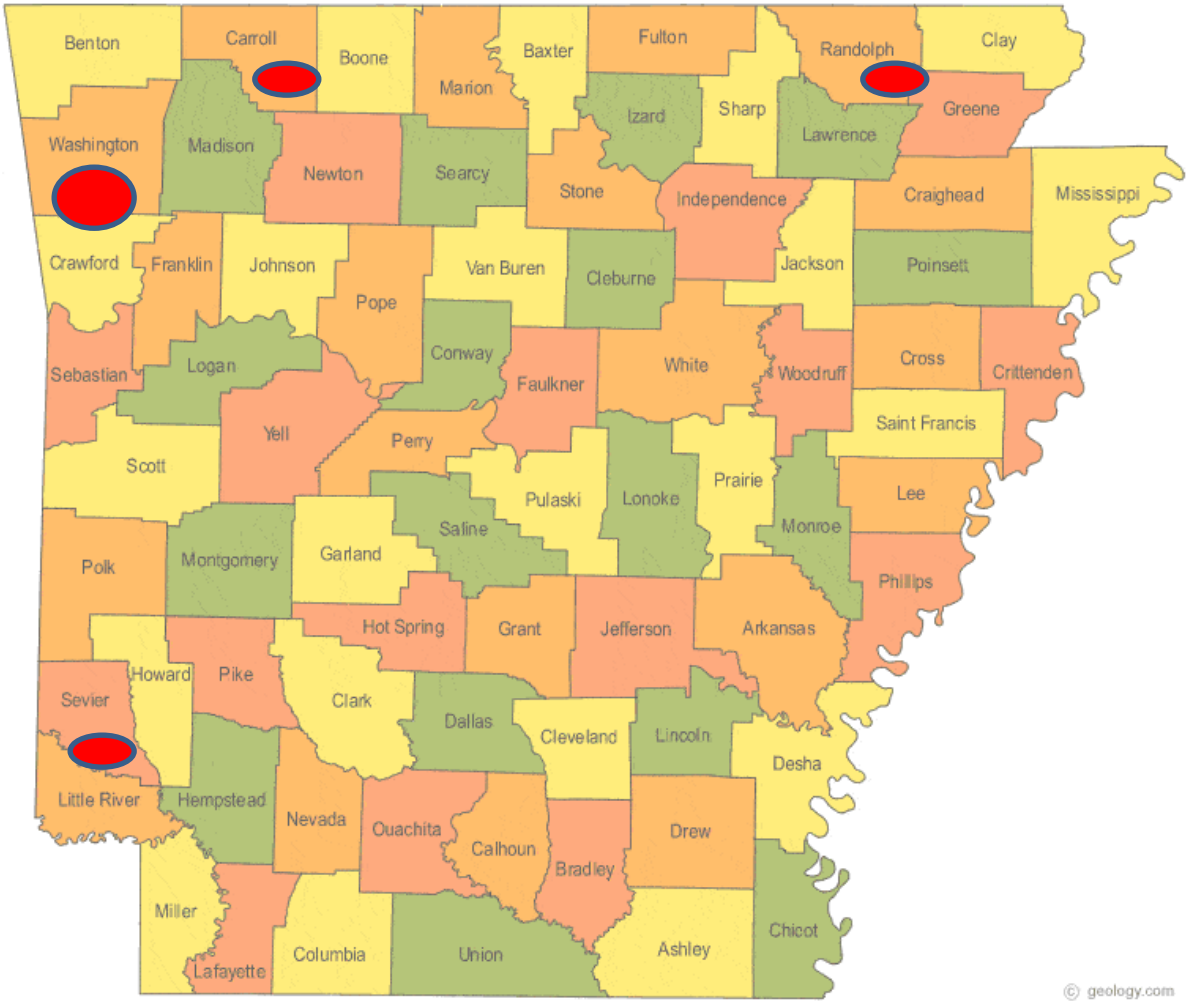
Epidemiologic Context

Infectious Period; How Long was it?

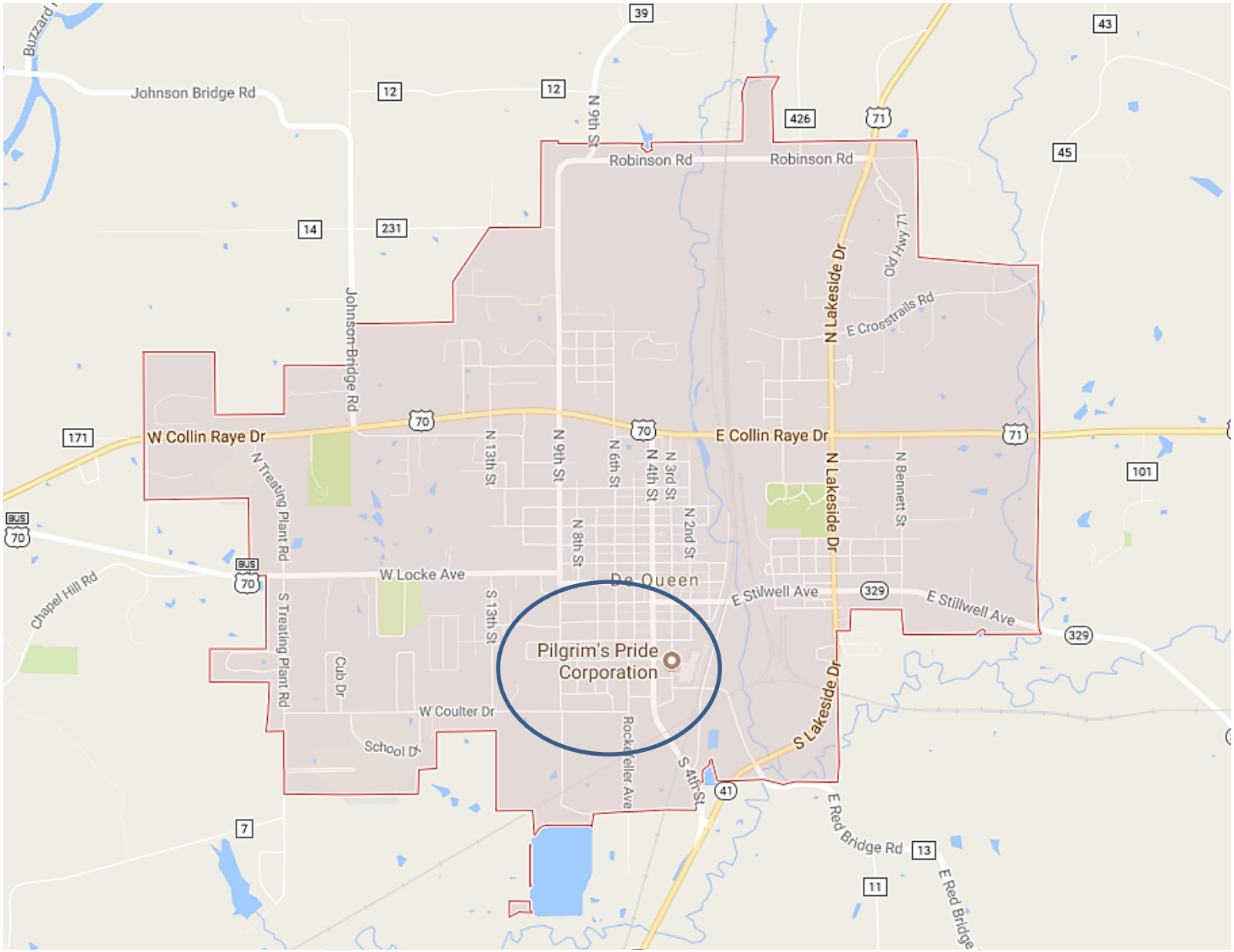


TB Among Marshallese in Arkansas, 2017 (n = 17)

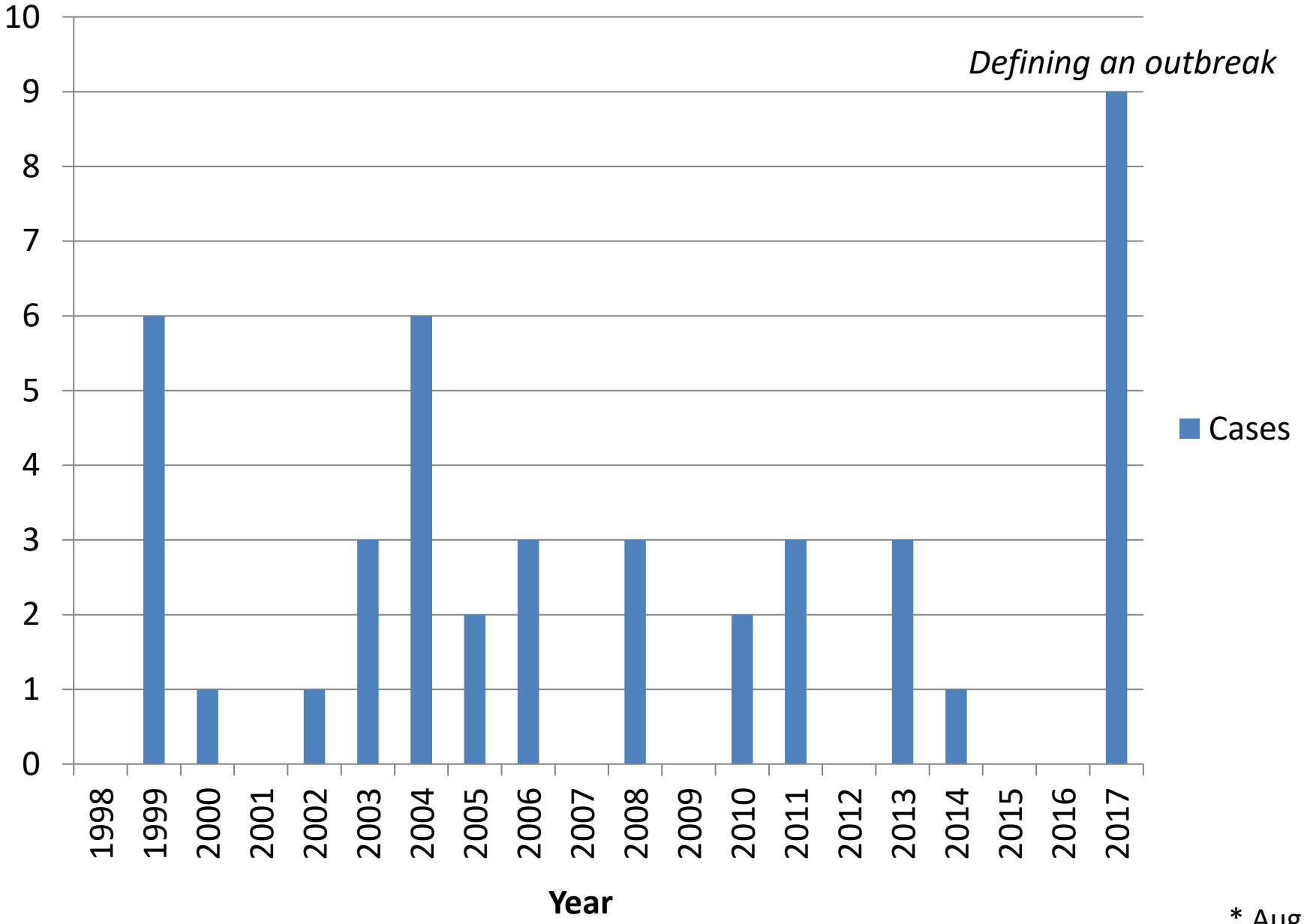
- ✓ 4 counties with Marshallese cases
- ✓ Population-based screening Beyond Springdale



DeQueen, Sevier County (Population 6749 ---2014)

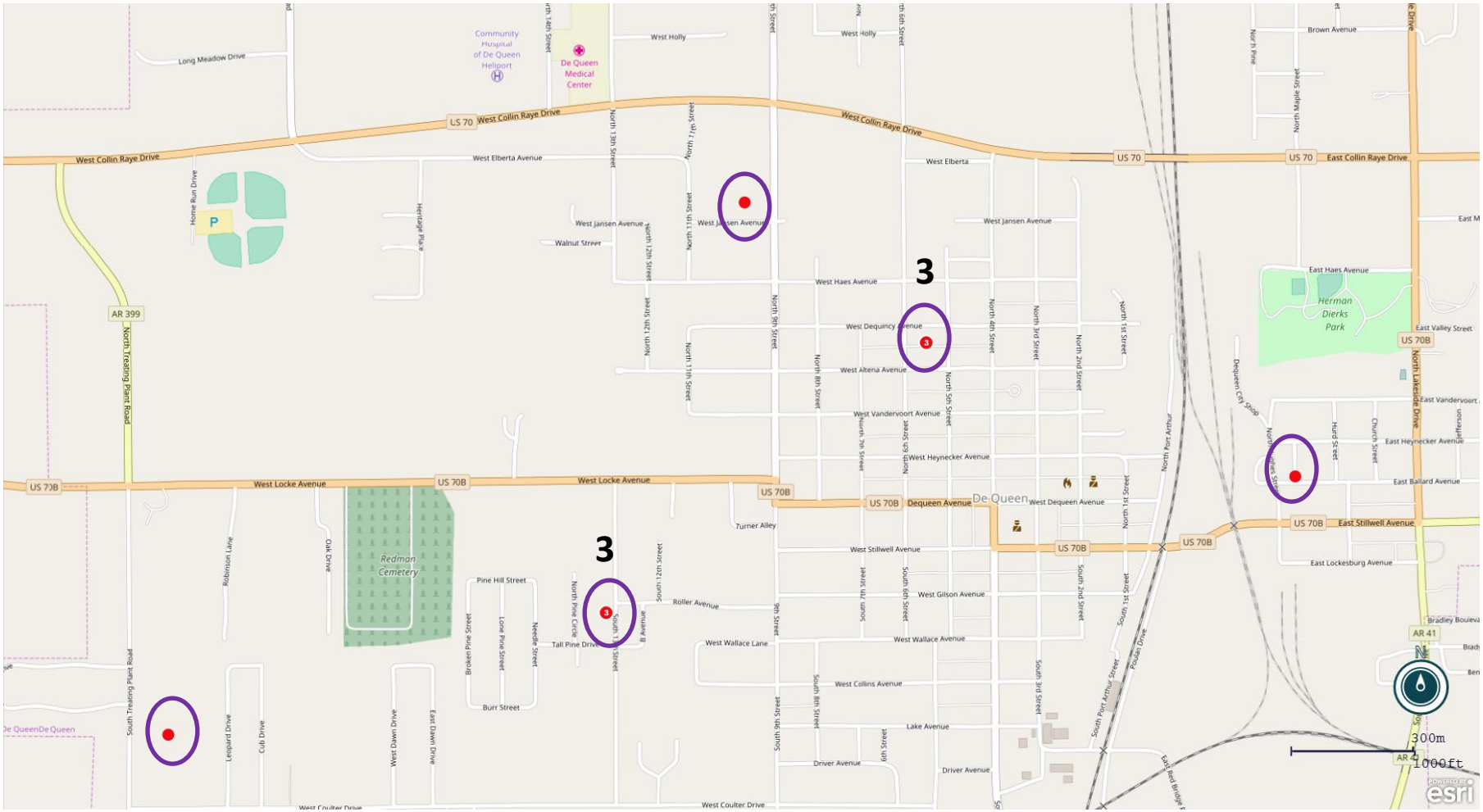


Tuberculosis Cases, Sevier County, Arkansas, 1998-2017*



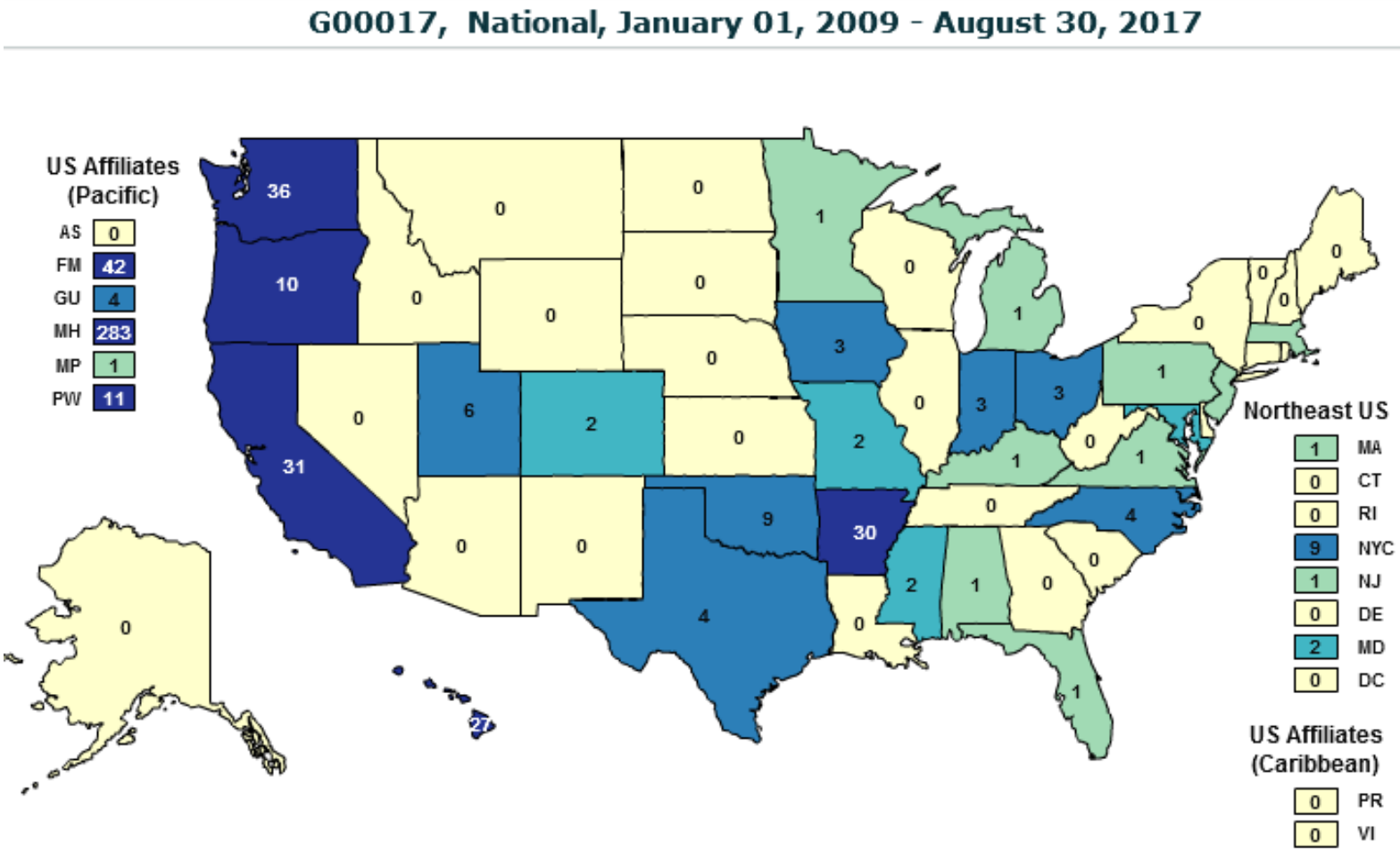
* August

Map of Nine TB Cases in Outbreak, DeQueen, Sevier County 2017



Molecular Epidemiology

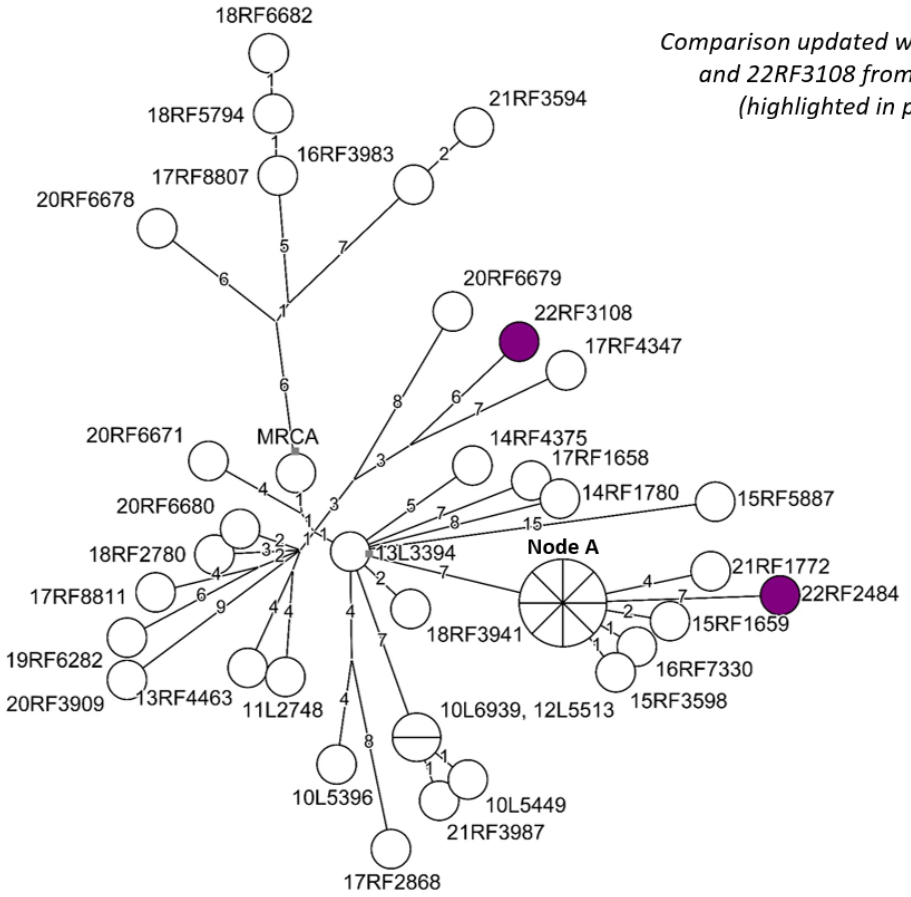
Source Case Genotype is G00017



Large Outbreak TB Among Marshallese in Arkansas

MTBC000151/G00017 in Arkansas

Results received 06/21/2022



Comparison updated with 22RF2484 and 22RF3108 from Arkansas (highlighted in purple)

Node A

14RF5553
14RF6403
14RF6407
14RF6452
15RF1658
15RF1886
15RF5047
15RF6372

Excluded isolates

16RF0898 (AR): no culture available
10L7792 (AR): no culture available
10L5397 (AR): no culture available

Field Trip to DeQueen, July 11-12

- ✓ **Jan Dougan, RN**
- ✓ **Robin Dorsey, RN**
- ✓ **Calmen Zachraias**
- ✓ **Laurie Bajo**

Effective
Efficient
Champions

- ✓ ***Hometown Health Improvement***
- ✓ ***Southwest Regional Leadership***

Residence for Source Case

16 of 24 (67.0%) extended family were infected

Sites of Potential Intense Transmission

Church 2

Church 1

DeQueen School District

- ✓ Superintendent Leadership
- ✓ School nurses and ADH Team
  - Marshallese students
  - Hispanic students
  - Directly Observed Therapy

Mr. Bruce Hill, Superintendent

Pilgrim's Pride Poultry Plant

- ✓ Met with officials
  - Shannon Wilson, RN
  - Mark Gross, Plant Safety Manager
- ✓ Expand testing to source case shift?
- ✓ Employee screening discussions to continue
  - Hometown Health Improvement role

Sevier County Health Officer

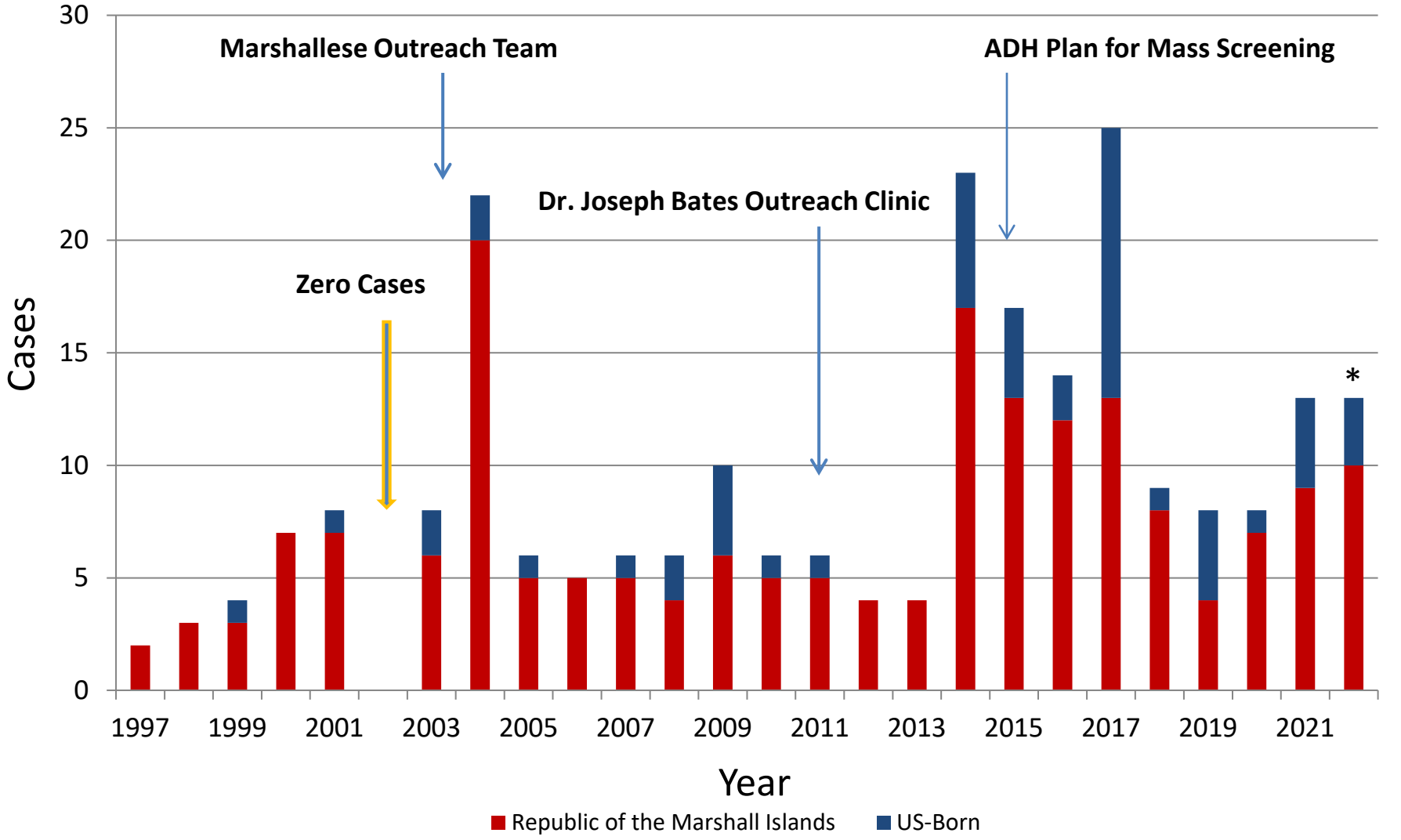
Jason D. Lofton, MD

- **Residency in Fayetteville**
- **Interested in diabetes management**
- **Engage physician practices in DeQueen**
- **DeQueen Memorial Hospital**
  - **Infection Control Nurse**
  - **ER Protocol**
  - **Courier to State Laboratory**

May 26 2017

Building Partnerships: TB Among Marshallese in AR

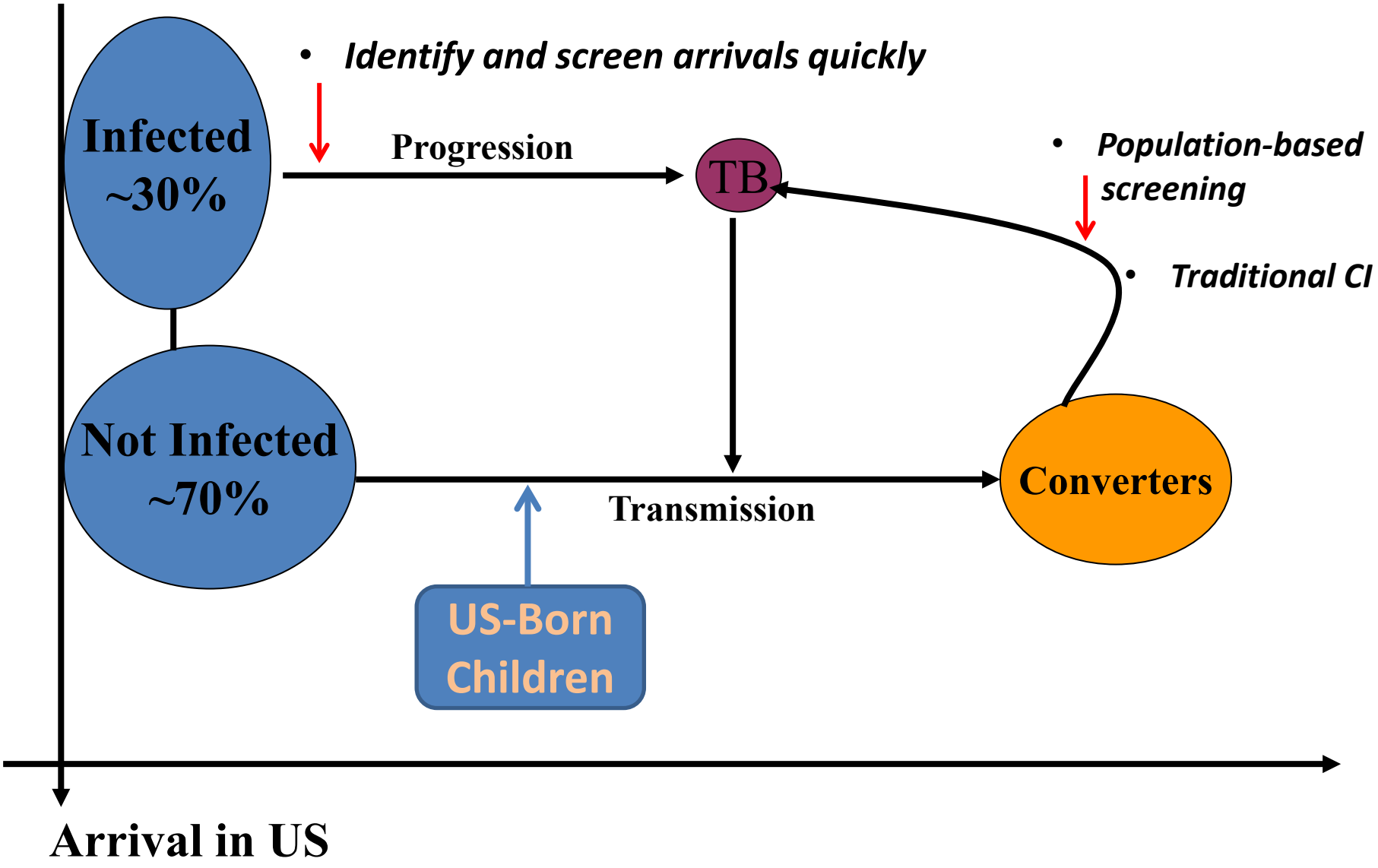
TB Among Marshallese in Arkansas, 1997–2022*
(N = 237)



* January-August

Epidemiology of TB Among Marshallese in Arkansas

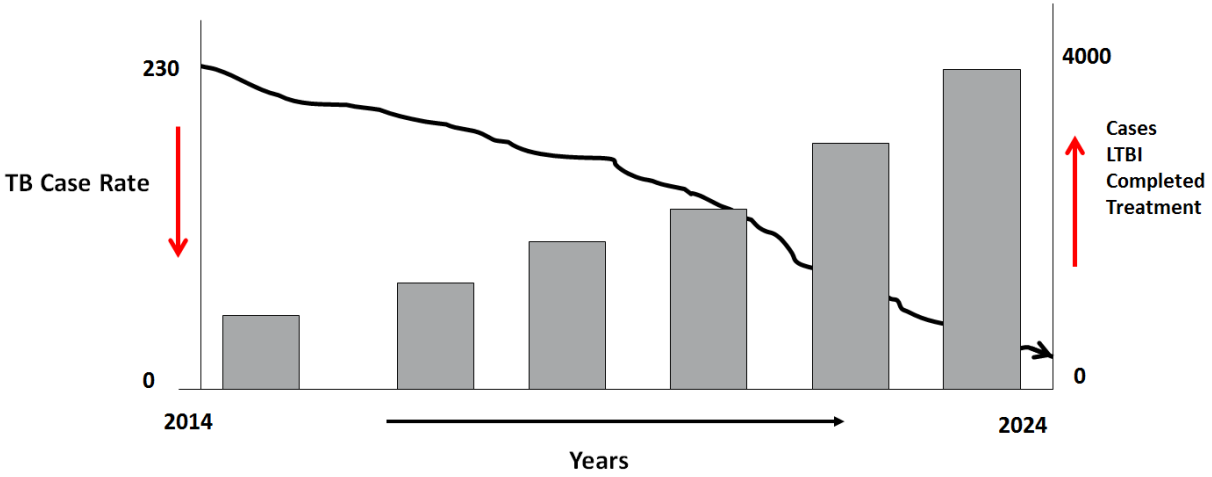
A Conceptual Framework: Reactivation and Transmission



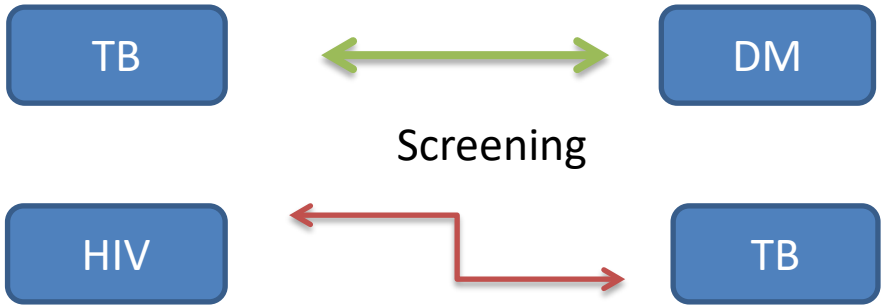
ADH Strategic Planning |TB

✓ **Population-based TB screening of Marshallese**

Second Generation Surveillance for Tuberculosis
Policy and Health Equity



✓ **Bidirectional screening**



What will you do differently about TB in Arkansas?

THINK TEST TREAT TB

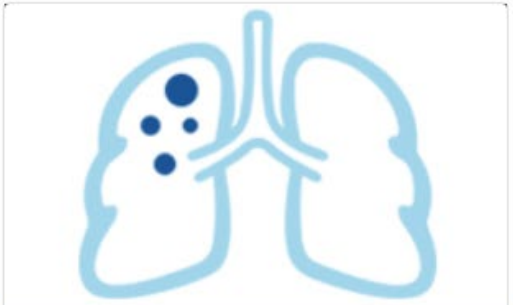
TB hides in plain sight. Millions of Americans are living with inactive TB.

Inactive TB in the United States

It is estimated that up to 13 million people in the United States live with inactive TB.

Risks of Untreated Inactive TB

Without treatment, 1 in 10 people with inactive TB will get sick with active TB disease, which can spread to others and be deadly.



Prevent TB

If you are diagnosed with inactive TB, there are several short and convenient treatment options available that can help protect you from getting sick with active TB disease.

Thank you!

Leonard Ntaate Mukasa
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Phone; 501.280.4106