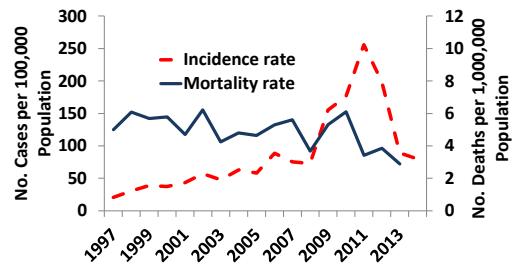


## Coccidioidomycosis: An Underreported Cause of Death — Arizona, 2008–2013

Jefferson Jones, MD MPH

Arizona Department of Health Services

### Incidence Rate and Mortality Rate\* of Coccidioidomycosis — Arizona, 1997–2014

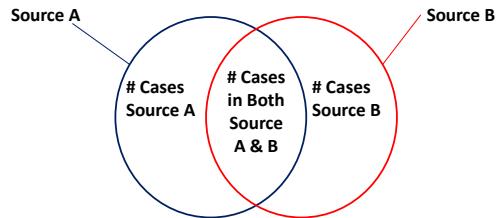


\*Using underlying cause of death on the death certificate

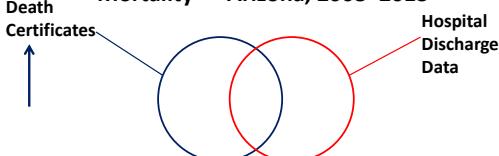
### Objectives

- To validate cocci mortality surveillance that used the underlying cause of death on death certificates by comparing it with mortality estimates by using additional sources

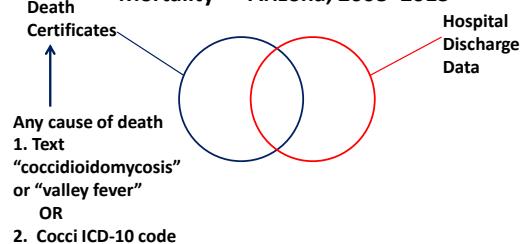
### Capture-Recapture

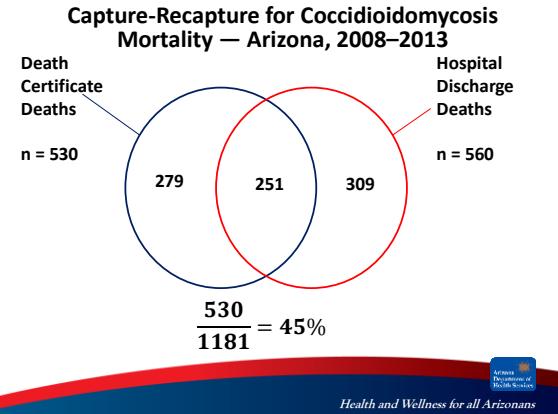
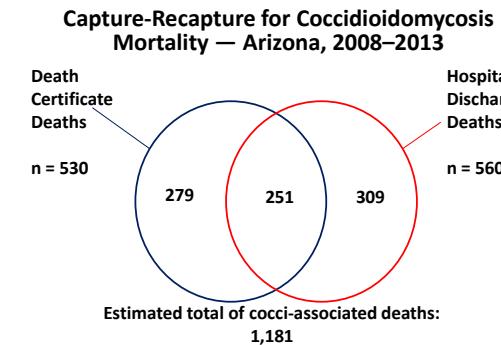
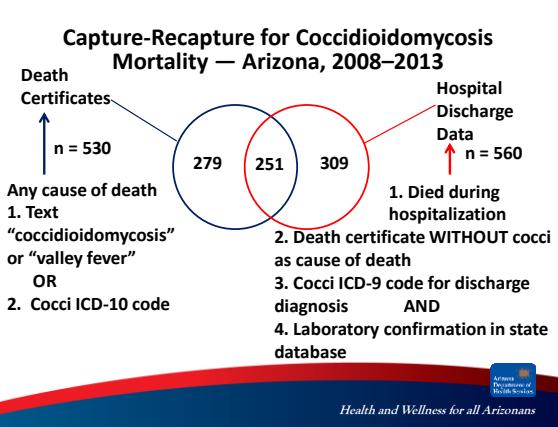
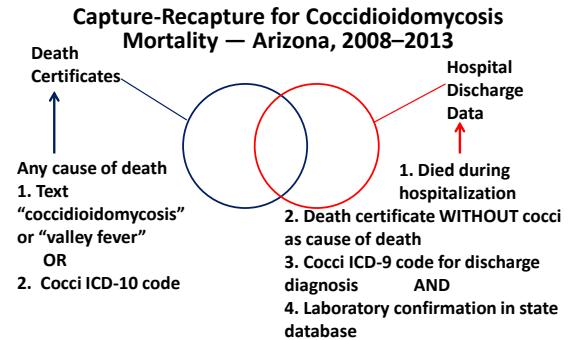
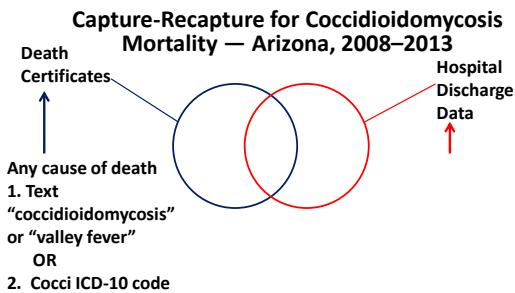


### Capture-Recapture for Coccidioidomycosis Mortality — Arizona, 2008–2013



### Capture-Recapture for Coccidioidomycosis Mortality — Arizona, 2008–2013





**Coccidioidomycosis-Associated Mortality Rate by Method—Arizona, 2008–2013**

Method	Mean Annual Mortality Rate per 100,000 Population	Rate Ratio
Capture-recapture	3.0	Ref
Hospital discharge data	1.4	2.1
Any cause of death on death certificate	1.4	2.2
Only underlying cause of death on death certificate	0.4	7.2



## Limitations

- Hospital discharge database is administrative
  - However, confirmed patients' death and diagnosis
  - Started validation study using medical records
- State database used for laboratory confirmation incomplete prior to 2012
  - Possibly led to underestimation
- Capture-recapture sources not independent
  - Calculated number of deaths underestimated

## Recommendations

- Use hospital discharge data in addition to death certificate data for cocci mortality
- Include training on certification of death
  - Medical schools
  - Residency programs
  - Medical boards

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## Capture Recapture Formula

		Source B		
		Included	Not Included	Total
Source	Included	$N_{AB}$	279	$N_A$
A	Not Included	309	???	???
	Total	$N_B$	???	

$$\text{Estimated Total} = \frac{(N_A + 1) \times (N_B + 1)}{(N_{AB} + 1)} - 1$$

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## Death certificates

- Provides cause of death
- Source of state and national mortality statistics
  - Determines research and public health funding priorities
  - Measures health status trends
- Causes of death on death certificates frequently inaccurate
  - Only 59% of causes of death on death certificates matched a hospital discharge diagnosis
  - Only 47% of autopsy-derived causes of death included in death certificate data
- Training on documenting cause of death uncommon
  - 8% of attending physicians
  - 24% of resident physicians

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### Documenting Cause of Death

MEDICAL CERTIFICATION SECTION	
CAUSE OF DEATH (LINE 1)	
→ A. Immediate cause of death	APPROXIMATE INTERVAL
→ B. Condition leading to line A	APPROXIMATE INTERVAL
→ C. Condition leading to line B	APPROXIMATE INTERVAL
→ D. Condition leading to line C	APPROXIMATE INTERVAL
CAUSE OF DEATH (LINE 2)	
Other significant conditions contributing to death but not resulting in the underlying causes given above	
TIME OF DEATH	
□ AM □ PM □ MILITARY	

"Underlying cause of death" determined by algorithm



### Incomplete Cause of Death Documentation

MEDICAL CERTIFICATION SECTION	
CAUSE OF DEATH (LINE 1)	
→ A. Pulmonary arrest	APPROXIMATE INTERVAL
→ B.	APPROXIMATE INTERVAL
→ C.	APPROXIMATE INTERVAL
→ D.	APPROXIMATE INTERVAL
CAUSE OF DEATH (LINE 2)	
TIME OF DEATH	
□ AM □ PM □ MILITARY	



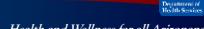
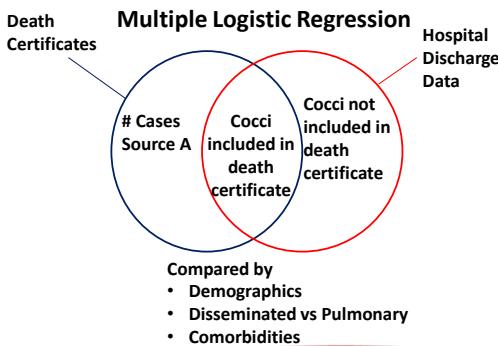
### Did Coccidioidomycosis Contribute to Death per Death Documentation?

MEDICAL CERTIFICATION SECTION	
CAUSE OF DEATH (LINE 1)	
→ A. Pulmonary arrest	APPROXIMATE INTERVAL
→ B. Coccidioidomycosis	APPROXIMATE INTERVAL
→ C. End stage COPD	APPROXIMATE INTERVAL
→ D.	APPROXIMATE INTERVAL
CAUSE OF DEATH (LINE 2)	
TIME OF DEATH	
□ AM □ PM □ MILITARY	



### Did Coccidioidomycosis Contribute to Death per Death Documentation?

MEDICAL CERTIFICATION SECTION	
CAUSE OF DEATH (LINE 1)	
→ A. Adult respiratory distress syndrome	APPROXIMATE INTERVAL
→ B. Klebsiella Sepsis	APPROXIMATE INTERVAL
→ C.	APPROXIMATE INTERVAL
→ D.	APPROXIMATE INTERVAL
CAUSE OF DEATH (LINE 2)	
TIME OF DEATH	
□ AM □ PM □ MILITARY	



### Significant Risk Factors for Coccidioidomycosis Included as Cause of Death

Risk Factor	Coccidioidomycosis listed as cause of death (n = 251)	Coccidioidomycosis not listed as cause of death (n = 309)	Adjusted Odds Ratio (95% Confidence Interval)
	No. (%)	No. (%)	
Disseminated disease	68 (27)	41 (13)	1.7 (1.1-2.8)
HIV	31 (12)	14 (5)	2.3 (1.1-4.7)



**Risk Factors Not Found to Be Significant for Coccidioidomycosis Included as Cause of Death**

- Age
- Sex
- Race/Ethnicity
- Immunocompromised Status
- Malignancy
- Underlying lung disease
- Diabetes

**Location of Disease**

Location	Coccidioidomycosis listed as cause of death (n = 251) No. (%)	Coccidioidomycosis not listed as cause of death (n = 309) No. (%)	Odds Ratio (95% Confidence Interval)
Pulmonary	171 (68)	221 (72)	Ref
Disseminated/meningitis	68 (27)	41 (13)	0.5 (0.3–0.7)
Chronic	6 (2)	14 (5)	1.8 (0.7–4.8)
Unspecified	6 (2)	33 (11)	4.3 (1.7–10.4)

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**Risk Factors for Coccidioidomycosis Omitted as Cause of Death**

Age in Years	Coccidioidomycosis listed as cause of death (n = 251)		Odds Ratio (95% Confidence Interval)
	No. (%)	No. (%)	
<25	14 (6)	6 (2)	0.4 (0.1–1.0)
25–64	123 (49)	143 (47)	ref
65–84	102 (41)	135 (44)	1.1 (0.8–1.6)
≥85	12 (5)	25 (8)	1.8 (0.9–1.8)

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**Risk Factors for Coccidioidomycosis Omitted as Cause of Death**

Sex	Coccidioidomycosis listed as cause of death (n = 251)		Odds Ratio (95% Confidence Interval)
	No. (%)	No. (%)	
Male	159 (63)	195 (63)	Ref
Female	92 (37)	114 (37)	1.0 (0.7–1.4)

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**Differences Among Hospital Discharge Deaths Race and Ethnicity**

Race / Ethnicity	Coccidioidomycosis listed as cause of death (n = 251)		Odds Ratio (95% Confidence Interval)
	No. (%)	No. (%)	
American Indian	12 (5)	23 (7)	1.5 (0.7–3.1)
Non-Hispanic Black	20 (8)	25 (8)	1.0 (0.5–1.8)
Hispanic	51 (20)	41 (13)	0.6 (0.4–1.0)
Non-Hispanic White	160 (64)	204 (66)	ref
Other	8 (3)	16 (5)	1.6 (0.7–3.8)

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**Type of Disease**

Location	Coccidioidomycosis listed as cause of death (n = 251)		Odds Ratio (95% Confidence Interval)
	No. (%)	No. (%)	
Pulmonary	171 (68)	221 (72)	ref
Disseminated/meningitis	68 (27)	41 (13)	0.5 (0.3–0.7)
Chronic	6 (2)	14 (5)	1.8 (0.7–4.8)
Unspecified	6 (2)	33 (11)	4.3 (1.7–10.4)

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### Risk Factors for Coccidioidomycosis Omitted as Cause of Death

Risk Factor	Coccidioidomycosis listed as cause of death (n = 251) No. (%)	Coccidioidomycosis not listed as cause of death (n = 309) No. (%)	Odds Ratio (95% Confidence Interval)
HIV Positive	31 (12)	14 (5)	0.3 (0.2–0.6)
Immuno-compromised	130 (52)	149 (48)	0.9 (0.6–1.2)
Malignancy	42 (17)	74 (24)	1.6 (1.0–2.4)
Chronic Lung Disease	67 (27)	105 (34)	1.4 (1.0–2.0)
Diabetes	70 (28)	95 (31)	1.1 (0.8–1.7)

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