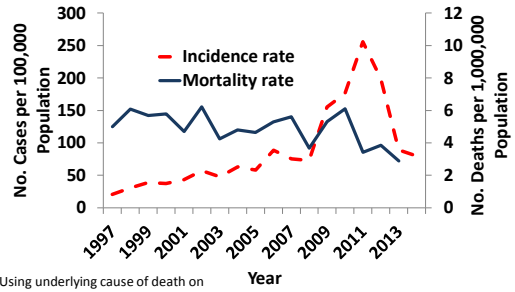


Coccidioidomycosis: An Underreported Cause of Death — Arizona, 2008–2013

Jefferson Jones, MD MPH
Arizona Department of Health Services

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



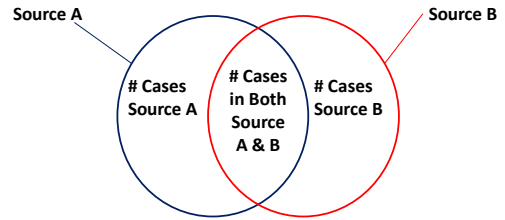
*Using underlying cause of death on the death certificate



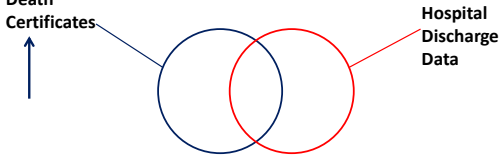
Objectives

- 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

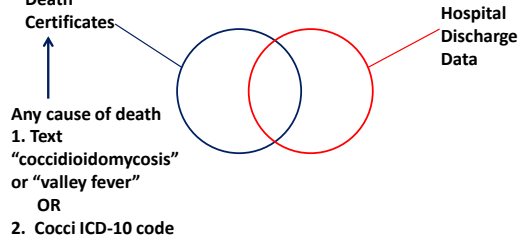
Capture-Recapture



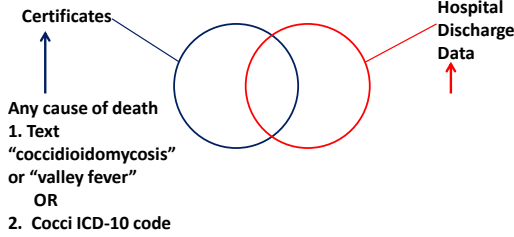
Capture-Recapture for Coccidioidomycosis Mortality — Arizona, 2008–2013



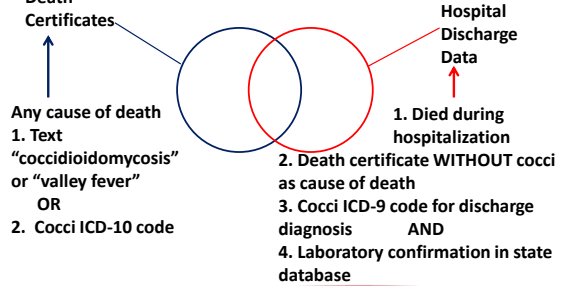
Capture-Recapture for Coccidioidomycosis Mortality — Arizona, 2008–2013



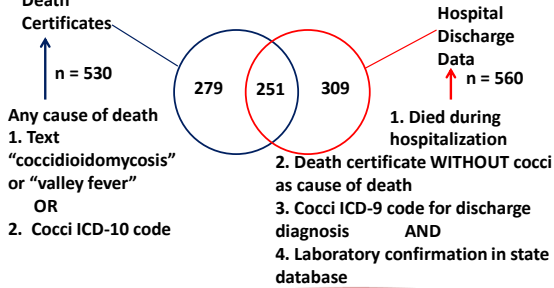
Capture-Recapture for Coccidioidomycosis Mortality — Arizona, 2008–2013



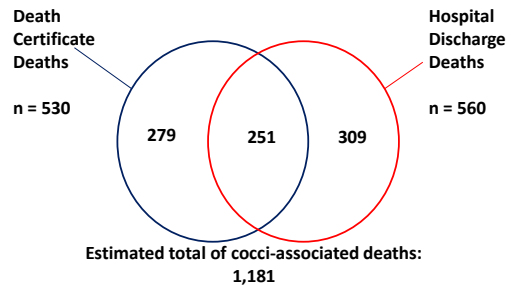
Capture-Recapture for Coccidioidomycosis Mortality — Arizona, 2008–2013



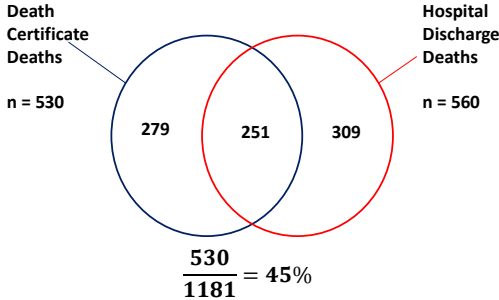
Capture-Recapture for Coccidioidomycosis Mortality — Arizona, 2008–2013



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



Acknowledgments

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- Lia Koski
- Jigna Narang
- Tammy Sylvester

CDC

- Kris Bisgard



Capture Recapture Formula

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

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



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



Documenting Cause of Death

| MEDICAL CERTIFICATE SECTION | |
|---|--|
| CAUSE OF DEATH/STAFF | |
| → A. Immediate cause of death | APPROXIMATE INTERNAL |
| → B. Condition leading to line A | APPROXIMATE INTERNAL |
| → C. Condition leading to line B | APPROXIMATE INTERNAL |
| → D. Condition leading to line C | APPROXIMATE INTERNAL |
| → Other significant conditions contributing to death but not resulting in the underlying causes given above | TIME OF DEATH <input type="checkbox"/> AM <input type="checkbox"/> PM <input type="checkbox"/> MILITARY |

"Underlying cause of death" determined by algorithm

Incomplete Cause of Death Documentation

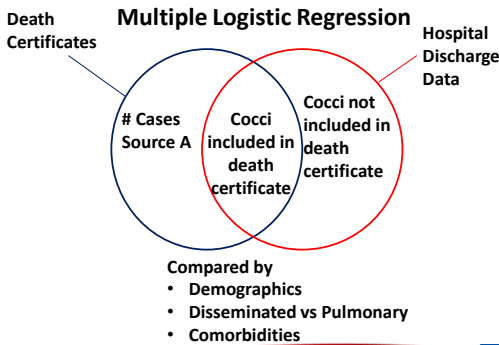
| MEDICAL CERTIFICATE SECTION | |
|-----------------------------|--|
| CAUSE OF DEATH/STAFF | |
| → A. Pulmonary arrest | APPROXIMATE INTERNAL |
| → B. | APPROXIMATE INTERNAL |
| → C. | APPROXIMATE INTERNAL |
| → D. | APPROXIMATE INTERNAL |
| → | TIME OF DEATH <input type="checkbox"/> AM <input type="checkbox"/> PM <input type="checkbox"/> MILITARY |

Did Coccidioidomycosis Contribute to Death per Death Documentation?

| MEDICAL CERTIFICATE SECTION | |
|-----------------------------|--|
| CAUSE OF DEATH/STAFF | |
| → A. Pulmonary arrest | APPROXIMATE INTERNAL |
| → B. Coccidioidomycosis | APPROXIMATE INTERNAL |
| → C. End stage COPD | APPROXIMATE INTERNAL |
| → D. | APPROXIMATE INTERNAL |
| → | TIME OF DEATH <input type="checkbox"/> AM <input type="checkbox"/> PM <input type="checkbox"/> MILITARY |

Did Coccidioidomycosis Contribute to Death per Death Documentation?

| MEDICAL CERTIFICATE SECTION | |
|--|--|
| CAUSE OF DEATH/STAFF | |
| → A. Adult respiratory distress syndrome | APPROXIMATE INTERNAL |
| → B. Klebsiella Sepsis | APPROXIMATE INTERNAL |
| → C. | APPROXIMATE INTERNAL |
| → D. | APPROXIMATE INTERNAL |
| → Coccidioidomycosis | TIME OF DEATH <input type="checkbox"/> AM <input type="checkbox"/> PM <input type="checkbox"/> 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) | Coccidioidomycosis not listed as cause of death (n = 309) | 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) |



Risk Factors for Coccidioidomycosis Omitted as Cause of Death

| Age in Years | Coccidioidomycosis listed as cause of death (n = 251) | Coccidioidomycosis not listed as cause of death (n = 309) | 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) |

Risk Factors for Coccidioidomycosis Omitted as Cause of Death

| Sex | Coccidioidomycosis listed as cause of death (n = 251) | Coccidioidomycosis not listed as cause of death (n = 309) | Odds Ratio (95% Confidence Interval) |
|--------|---|---|--------------------------------------|
| | No. (%) | No. (%) | |
| Male | 159 (63) | 195 (63) | Ref |
| Female | 92 (37) | 114 (37) | 1.0 (0.7–1.4) |



Differences Among Hospital Discharge Deaths Race and Ethnicity

| Race / Ethnicity | Coccidioidomycosis listed as cause of death (n = 251) | Coccidioidomycosis not listed as cause of death (n = 309) | 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) |

Type of Disease

| Location | Coccidioidomycosis listed as cause of death (n = 251) | Coccidioidomycosis not listed as cause of death (n = 309) | 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) |



Risk Factors for Coccidioidomycosis Omitted as Cause of Death

| Risk Factor | Coccidioidomycosis listed as cause of death (n = 251) | Coccidioidomycosis not listed as cause of death (n = 309) | Odds Ratio (95% Confidence Interval) |
|----------------------|--|--|--------------------------------------|
| | No. (%) | No. (%) | |
| 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) |



Health and Wellness for all Arizonans