MAYO CLINIC

Point of Care Testing in Microbiology and Laboratory Diagnosis of Valley Fever

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DISCLOSURES:

None

Objectives

- *Be able to discuss important considerations of POC testing for microbiology*
- *Be able to explain why POC molecular testing has unique costs and benefits*
- *Be able to explain available diagnostic tests for valley fever*
- *Be able to discuss the role of laboratory test results in diagnosis and prognosis of Valley Fever*

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Point of Care Molecular Testing:

the Dawn of a New Age. Maybe.

Definitions

- POC: Point of Care (does not mean waived)
- POI: Point of Impact (when POC is done right)
- Near-patient: in-room, ED, urgent care, etc.
- Waived Status: FDA cleared to be run by non-laboratory staff
- Moderate Complexity: FDA cleared to be run by non-certified laboratory technologists.

Influenza Background

- RNA virus—highly variable
- Transmission: large droplets
- Fever, muscle aches, headache, fatigue, cough, sore throat
- Yearly epidemics
  - >200,00 hospitalized/year
  - >36,000 deaths/year
- Keys to reduce transmission:
  - Hand hygiene
  - Vaccination
- Antiviral treatments available

- *See also:* 2015 Hot Topic Influenza Update by Dr. Matt Binnicker.

Vaccines for 2016/2017

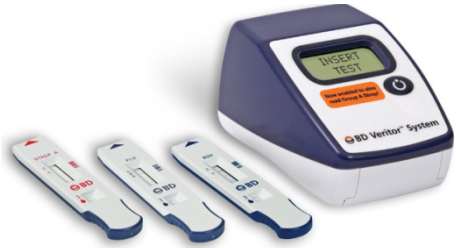
- World Health Organization organizes a group who recommends vaccine composition
- In USA, FDA chooses final vaccine composition and approves vaccine products
- USA: 2016/2017 Vaccines contain 3 or 4 strains
  - Influenza A strains: H1N1, H3N2
  - Influenza B strain(s)
- FDA Approved vaccine formulations:
  - IIV: Inactivated Influenza Vaccine (injection)
  - RIV: Recombinant Influenza Vaccine (injection)
  - For >65 years (high dose or adjuvant)
  - Egg-free (grown in cell culture)

Vaccination Updates for 2016/2017

- Advisory Committee on Immunization Practices (ACIP)
  - Appointed by the Secretary of US Department of Health and Human Services (DHHS)
  - Decides how to use vaccines
- The nasal spray vaccine (Live Attenuated Influenza Vaccine—LIAV) is not recommended for 2016/2017 season
- Egg allergies:
  - Mild egg allergies (hives), any licensed vaccine
  - More severe symptoms:
    - Any licensed vaccine
    - Given in a medical setting with health care supervision to recognize and manage any allergic reaction.
  - No longer 30 minute wait

Traditional Methods of Detection

- Culture
  - Patient: slow and moderate sensitivity
  - Laboratory: high level of space and effort required, viral strains helpful for public health
- Rapid antigen testing
  - Patient: quick and variable sensitivity
  - Laboratory: varied impact
    - Point of Care—less laboratory interaction
    - Laboratory performed—simple but effort intensive
    - Negative results should be confirmed by alternative methods
  - Prevalence affects performance
    - Positive result in low prevalence more likely false-positive
    - Negative result during high prevalence more likely false-negative



POC ≠ POC

- Chemistry usually measures things that “should be there”
- Microbiology testing usually has a reference range of “negative.”
- POC for Micro
  - Downside: POC for antigens are not sensitive (mediocre performance)
  - Upside: POC for antigens are not
  - Sensitive (low risk for contamination)

Clinical Factors to consider

- Actionable information?
- Impact of TAT on outcome & cost?
- Surrogate measure or information available to approximate same answer?
- Specimen integrity (labeling, contamination, temperature, timing, storage).
- Risk/benefit of empiric treatment
- Seasonality of testing
- Potential for contamination within collection & testing environment

Operational Factors

- Cost of POC test vs. alternatives
- Cost vs. Charge
- Opportunity cost of space & staff, menu of platform?
- Training of staff collecting/performing testing
- Logistics of training, competency, maintenance, quality control, proficiency, procedures, etc.
- Comparison to existing and available gold standards
- Seasonality of testing
- Logistics/daily routine of testing needs
- Waste, “green” supplies

Psychology of testing

- Why do we test?
  - To treat provider? Patient? Parent?
  - Interesting? Available?
- Sensitivity vs. Specificity
- PPV vs. NPV (Positive & Negative Predictive Value)
  - Affected by age, season, geography, etc.
- The power of objective, black & white print
- Permanence: cannot be undone, ignored, or discounted

Case 1

- January 2014: 3 year old girl with 2 day history of runny nose, malaise, irritability
- Taken to CVS Minute Clinic
- Rapid Influenza test negative
- What do we do next?

Pilot POC Micro Lab

- 23 tests
- TAT < 4 hr
- 2 years
- 51,179 tests
- 6244 Dx
- 8% of tests influenced management of ED patients

Outcome	Test result	n*
Isolation for contagiousness	Positive influenza detection	545
	(A/H1N1)	(335)
	Positive RSV detection	320
	Positive *B. pertussis* detection	14
	Positive rotavirus/adenovirus detection	96
	Positive *C. difficile* detection	7
Avoid unnecessary hospitalization	Positive enterovirus detection	117
Avoid unnecessary treatment	Positive RSV detection	320
	Negative procalcitonin detection	294
	Negative *S. pyogenes* detection	1,827
	Infectious mononucleosis diagnosis	17
	Positive enterovirus detection	117
	Negative *S. agalactiae* detection	763
	Dengue diagnosis	9
	C. tetani antibodies	8
Replace empiric with documented treatment	Positive A/H1N1 influenza detection	335
	Presence of urinary pneumococcal antigens	10
	Presence of urinary *L. pneumophila* antigens	9
	Positive *M. pneumoniae* detection	21
	Bacterial meningitis	13
	HSV meningitis	1
	Malaria	149

Cohen-Bacrie S, Ninove L, Nougairède A, Charrel R, et al. (2011) Revolutionizing Clinical Microbiology Laboratory Organization in Hospitals with In Situ Point-of-Care. PLoS ONE 6(7): e22403. doi:10.1371/journal.pone.0022403
http://www.plosone.org/article/info:doi/10.1371/journal.pone.0022403

Influenza: case example for POC issues

- Seasonal
- Treatable (sort of)
- Treatment success is time-dependent
- Large strain on ED/urgent care
- Age differences
- Many tests available

Influenza POC - Antigen

- Manual card tests
  - Many assays available
- Automated card reader tests
  - BD Veritor
  - 3M Sophia

FDA Caution on rapid Influenza

http://www.fda.gov/MedicalDevices/Safety/AlertsandNotices/TipsandArticlesonDeviceSafety/ucm109385.htm

Specimen	Influenza type	Population [a]	Sensitivity (95% CI) [c]	% Specificity (95% CI) [c]
Throat swab	Influenza A	Pediatric [b]	65 to 90	81 to 91
		Adult	24 to 91	69 to 94
Throat swab	Both Influenza A & B	Not specified	59 to 82	81 to 93
Nasopharyngeal wash/aspirate	Influenza A	Pediatric [b]	82 to 95	98 to 100
		Adult	53 to 87	90 to 100
Nasal wash	Influenza A	Pediatric [b]	36 to 88	92 to 99
		Adult	9 to 99	59 to 100
Nasal wash and aspirate	Influenza A	Not specified	65 to 84	95 to 99
Nasal swab	Both Influenza A & B	Not specified	65 to 87	87 to 97

Table 2. 95% Confidence Intervals: Data from two tests cleared during the past few years.

[a] From the U.S., Australia, or New Zealand during seasons where A/H3 and A/H1 were predominant circulating influenza A viruses (derived from WHO Flunet, http://gamapserver.who.int/GlobalAtlas/home.asp)

[b] Age range not specified; majority are <10 years

[c] 95% Confidence Interval

Quidel Sophia

Table 5

Performance Compared to Culture for Each Sample Type by Age Group for Influenza A

	Nasal Swabs		Nasopharyngeal Swabs		Nasopharyngeal Aspirate/Wash	
	Sensitivity	**Specificity**	**Sensitivity**	**Specificity**	**Sensitivity**	**Specificity**
All Ages	**90%** (124/138) (95%CI=84%-94%)	**95%** (500/527) (95%CI=93%-96%)	**97%** (100/103) (95%CI=91%-99%)	**95%** (596/630) (95%CI=93%-96%)	**99%** (68/69) (95%CI=91%-100%)	**96%** (554/580) (95%CI=93%-97%)
<6 years	**95%** (62/65) (95%CI=87%-99%)	**95%** (210/221) (95%CI=91%-97%)	**97%** (61/63) (95%CI=89%-100%)	**94%** (444/470) (95%CI=92%-96%)	**99%** (68/69) (95%CI=91%-100%)	**95%** (544/570) (95%CI=93%-97%)
6 to 21 years	**87%** (46/53) (95%CI=75%-94%)	**95%** (193/204) (95%CI=91%-97%)	**97%** (35/36) (95%CI=85%-100%)	**94%** (136/144) (95%CI=89%-97%)	**N/A** (0/0)	**100%** (10/10) (95%CI=68%-100%)
22 to 59 years	**78%** (14/18) (95%CI=54%-92%)	**96%** (82/85) (95%CI=90%-99%)	**100%** (4/4) (95%CI=45%-100%)	**100%** (15/15) (95%CI=76%-100%)	**N/A** (0/0)	**N/A** (0/0)
60 Years and up	**100%** (2/2) (95%CI=29%-100%)	**88%** (15/17) (95%CI=64%-98%)	**N/A** (0/0)	**100%** (1/1) (95%CI=17%-100%)	**N/A** (0/0)	**N/A** (0/0)

BD Veritor

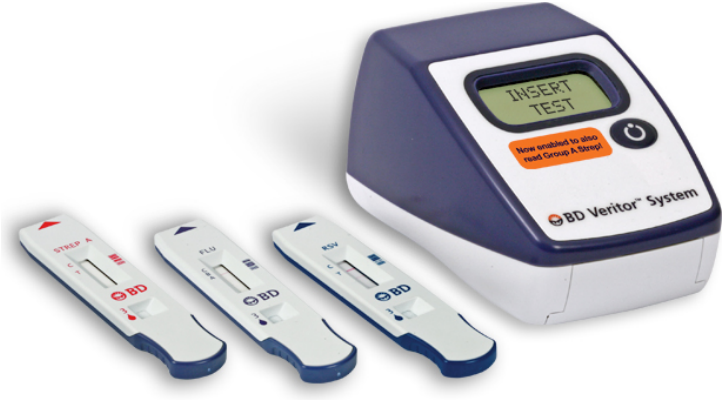


Table 1: Summary of the Performance of the BD Veritor System for Rapid Detection of Flu A+B Test Compared to PCR for All Swabs - U.S. Sites

	Reference PCR		
POC: BD Flu A	P	N	Total
P	122	8	130
N	33*	352	385
Total	155	360	515
Reference Method: PCR PPA: 78.7% (95% C.I. 71.6%-84.4%) NPA: 97.8% (95% C.I. 95.7%-98.9%)			

	Reference PCR		
POC: BD Flu B	P	N	Total
P	75	2	77
N	26**	412	438
Total	101	414	515
Reference Method: PCR PPA: 74.3% (95% C.I. 65%-81.8%) NPA: 99.5% (95% C.I. 98.3%-99.9%)			

* Of the 33 PCR positive, **BD Veritor** negative Influenza A specimens, eight were positive in the **BD Veritor** assay using a second swab specimen (reference method specimen) collected from the same patient.

** Of the 26 PCR positive, **BD Veritor** negative Influenza B specimens, six were positive in the **BD Veritor** assay using a second swab specimen (reference method specimen) collected from the same patient.

Value of results depends on: Sensitivity, Specificity, **Prevalence**

Consider a test: Sensitivity = 80%
Specificity = 95%

Prevalence affects Value in this way:

Prevalence	False Pos in 1000 tests	True Pos in 1000 tests	Negative Predictive Value (%)	Positive Predictive Value (%)
0.1	50	0.8	100	1.6
2.5	49	20	99.5	29.1
25	37.5	200	93.4	84.2
90	5	720	34.5	99.3

Categories of molecular testing

- Regulatory status
  - LDT (Lab developed tests)
  - FDA cleared
- Operators
  - Waived (non-laboratory personnel)
  - Moderate complexity
  - High complexity
- Analytes
  - Single
  - Small panel
  - Multiplex/syndromic

Molecular Detection: nucleic acid amplification tests

- Paradigm 1: single analyte tests
- Paradigm 2: syndromic testing panels
- Paradigm 3: rapid point of care tests

Paradigm 1: Single analyte tests

- Examples
  - Laboratory Developed Tests (LDTs)
  - FDA cleared assays
- Laboratory impact
  - New instruments, new methods
  - New laboratory skills
  - High cost, high effort, often batched
- Patient impact
  - Higher charge
  - Better sensitivity/specificity
  - Longer time to result than rapid antigen tests
  - Care decisions made on reliable information

Paradigm 2: Syndromic Testing

- Examples:
  - Influenza A/B and RSV
  - 3-20 pathogens including non-virus targets
- Laboratory Impact:
  - New instruments, often lower complexity
  - New Quality control challenges
  - High cost, logistics of ordering & reporting
- Patient impact:
  - High or very high charge
  - Often faster than single analyte testing
  - Care decisions may not change for some positive results on outpatients

Paradigm 3: Point of Care

- Examples:
  - Several FDA cleared assays with results <30 minute
  - Waived status: can be performed outside laboratory
- Laboratory Impact:
  - High effort if performed in lab
  - Loss of control if performed in clinics
  - Revenue? Reporting/documentation?
- Patient Impact:
  - Care decision can be made before patient leav
  - May be best tool for antimicrobial stewardship
  - Testing may occur when inappropriate
  - Positive test may not lead to change in care
    - Antivirals can be expensive
    - Antibacterials may be warranted for secondary bacte infections

Copernican Revolution

- 10-15 years ago:
  - Culture was common and default gold standard
  - Antigen testing was widespread
  - Molecular testing was emerging
- Now
  - Culture use is less common
  - Antigen tests: use carefully and with ancillary testing
  - Wide array of options for molecular

Test Selection: Step 1
Define Current State and Resources

- Evaluate current testing practices and identify any rapid antigen testing that may be occurring
- Consider standalone Influenza testing vs. small panels vs. syndromic panels
- Consider space and skills to support point of care and/or rapid testing in the laboratory

Test Selection: Step 2
Engage the Practice to Support Needs

- Start with the patient and provider
  - What decisions are made? What actions taken?
  - If treatment is not indicated, testing may not be needed
  - Define range of opportunity
    - Time to result
    - Local resources for testing or post-visit support
- Engage institutional leadership
  - Influenza testing/treatment recommendations
  - Evaluate opportunities to support the recommendations

Test Selection: Step 3
Synthesize needs and resources

- Evaluate intersection of available resources and opportunities to impact care decisions
- Educate practice on orders, methods, expectations
- Communicate
  - Email, departmental visits, internal web sites
- Evaluate
  - Test utilization
  - Cost, reimbursement, FTE impact

POC Molecular testing

- Questions?

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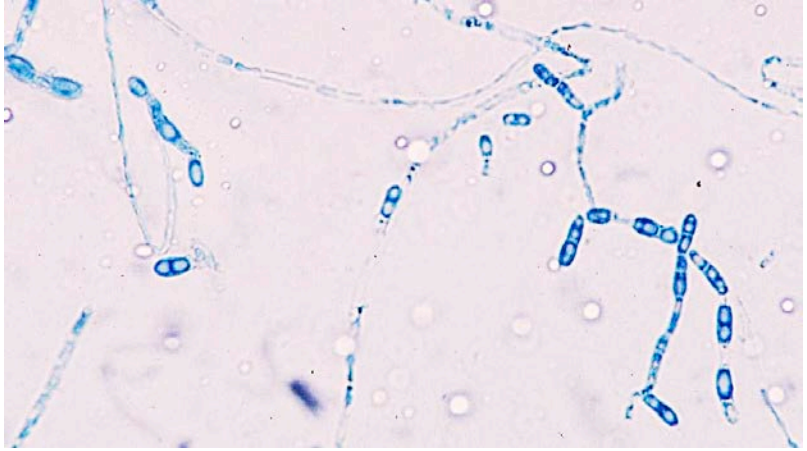
Laboratory Diagnosis of Valley Fever.

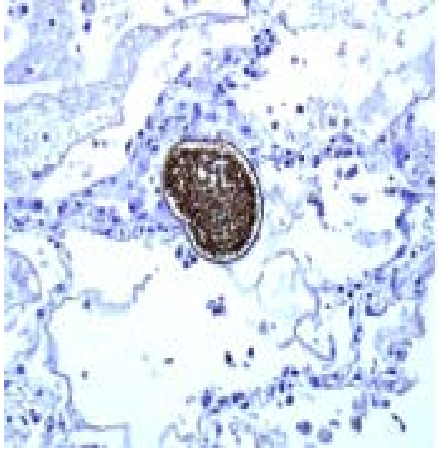
You say “Valley Fever,” I say Coccidioidomycosis

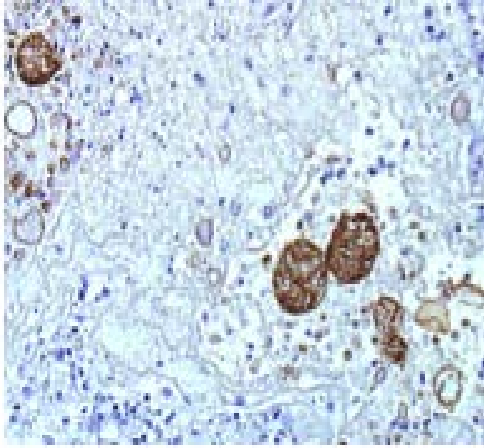
Coccidioides biology

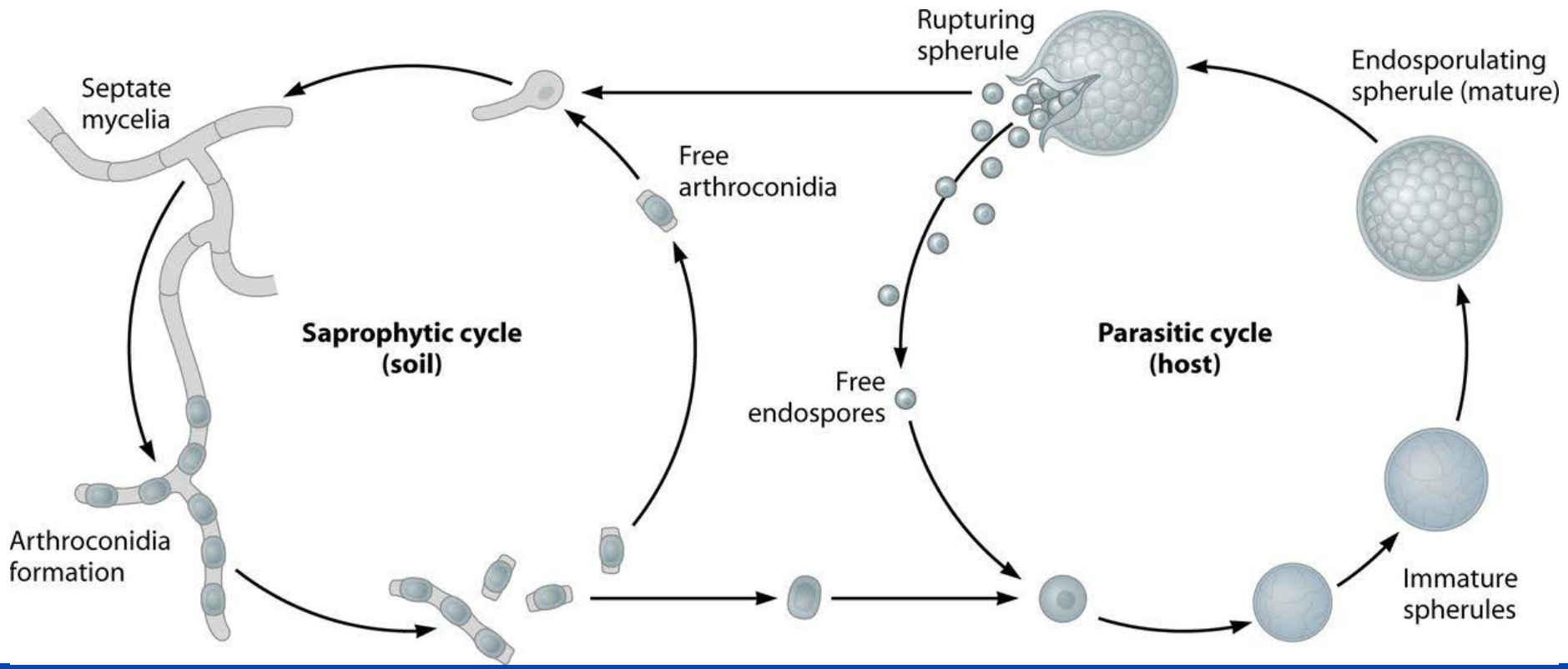
- Order: Onygenales
  - (also includes *Histoplasma*, *Blastomyces* and *Paracoccidioides*)
- Family: Onygenaceae
  - Only dimorphic pathogen within this family
- Two species, one disease
  - *C. immitis*: California
  - *C. posadasii*: Arizona and everywhere else

Dr. Glenn Roberts, Mayo Clinic









Galgiani et al. (2013). Clin. Microbiol. Rev. vol. 26 505-525

Coccidioides epidemiology

- 20,000 reported infections each year
- >120,000+ unreported cases
- 10-30% of community acquired pneumonia (CAP) in endemic areas

Organism	Incidence per 100,000
Coccidioides sp	42.6 (reported) ~200 (inc. unreported)
Blastomyces	6.1
Histoplasma	2
Borrelia burgdorferi	50-100

Diagnostic modalities for Valley Fever

- Culture
- PCR
- Serology
- Antigen testing
- Skin testing
- Radiology

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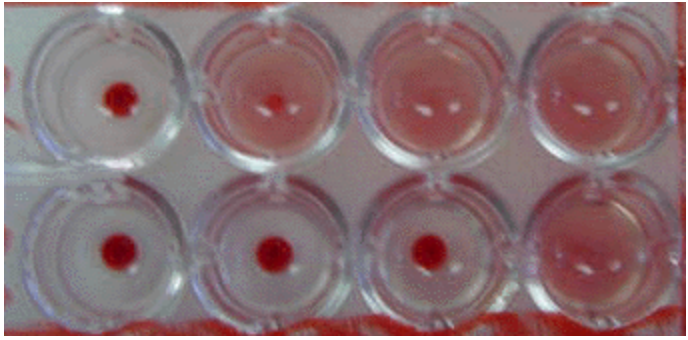
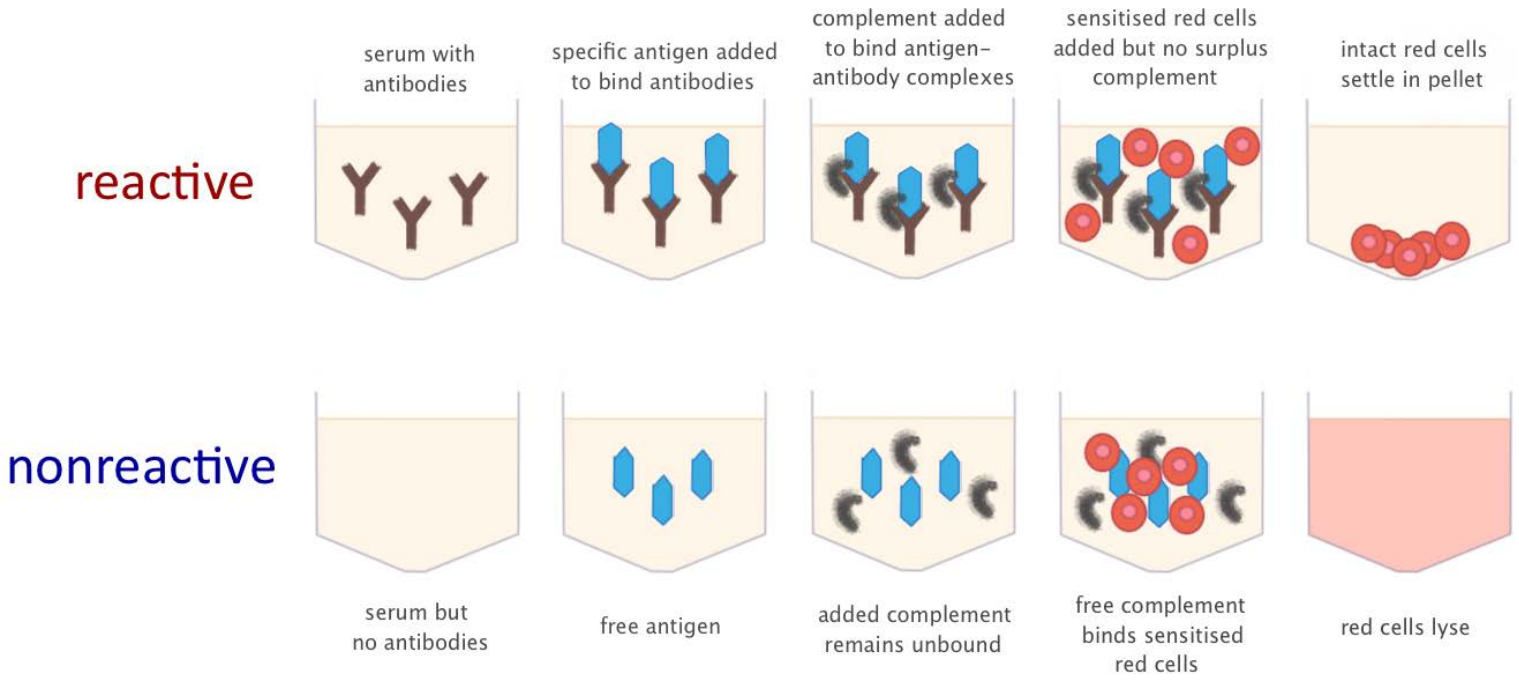
Complement Fixation



Virology-online.com

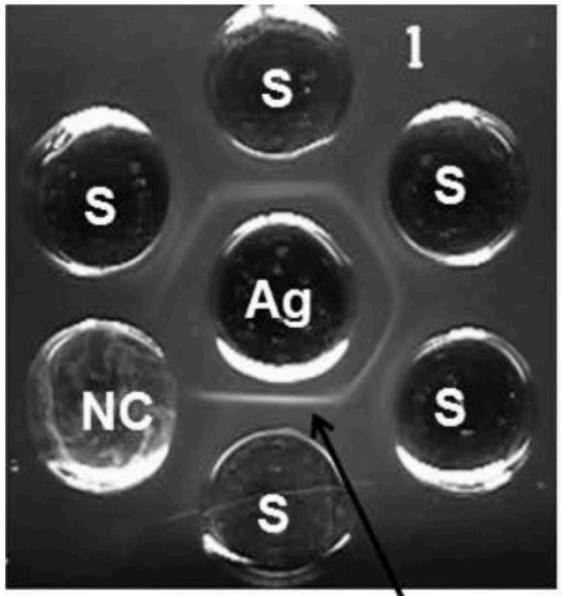


http://microgrnome.priobe.net/2013/08/how-serology-works/

tjji 2013. Creative Commons

Immunodiffusion

- Use different antigens to test
  - IgG (IDCF) chitinase
  - IgM (IDTP) beta-glucosidase

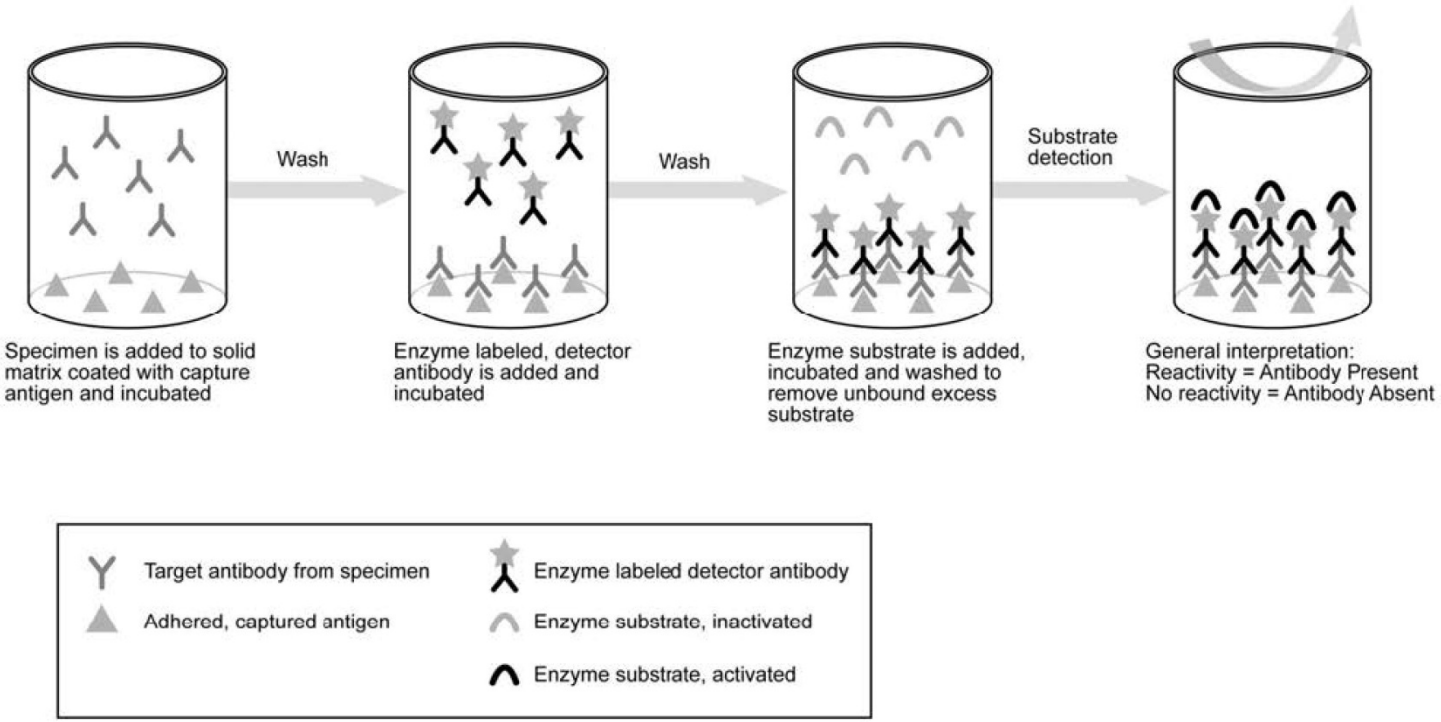


S – Serum
Ag – Purified Antigen
NC – Negative Control

Precipitation Band

Enzyme Immunoassay

- FDA cleared (Meridian, Immuno-Mycologics [Immy])
- Can be automated



MiraVista antigen test

- Antibodies against *Coccidioides* galactomannan
- Sensitivity is moderate (50-73%, serum & urine)
- Specificity concerns with cross reactivity to *Histoplasma* and/or *Blastomyces*
- Recently shown useful for CNS infections by testing CSF specimens (93% sensitive, vs. 85% for EIA IgG and 85% for ID & CF combined).

Kuberski et a. (2007) Clin Infect Dis. 44:50.
Durkin et al (2008). Clin Infect Dis 47:69.
Durkin et al. (2009). Clin Vacc Immunol **16**(10): 1453-1456
Kassis et al. (2015) Clin Infect Dis. 61:1521.

Diagnostic modalities for Valley Fever

- Culture
- PCR
- Serology
- Antigen testing
- Skin testing
- Radiology

Skin testing

- 1930s, C.E. Smith and colleagues developed Coccidioidin (mycelial extract). Used for many epidemiological studies in form of a skin test.
- Similar to TB skin test, measures Delayed-Type Hypersensitivity (DTH)
- 1950s: spherules propagated in culture enabled development of spherulin (late 1970s)
- 1987: more concentrated form of spherulin introduced.
- 1999: spherulin no longer available.

Diagnostic modalities for Valley Fever

- Culture
- PCR
- Serology
- Antigen testing
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Spherusol™

- FDA cleared (2011) for determining cell-mediated immunity to *Coccidioides* in patients with established history of pulmonary coccidioidomycosis, ages 18-64.
  - Solution and placement:
    - Preservative is phenol
    - Performance comparable to earlier literature using spherulin
    - 0.1 mL of solution placed intradermally and read at 48 hours.
    - Induration of ≥5 mm is positive (redness/discoloration not used)
    - Immediate reaction within 15-60 minutes does not count (true positive reaction does not occur until 6 hours
  - Interpretation:
    - Patients develop positivity in 3 days to 3 weeks of symptom onset
    - Does not affect serologic testing
    - Positive result suggests good prognosis and development of protective immunity.
    - Serial testing may be helpful

Wack et al. (2015) Clin. Infect. Dis. 61:787

Spherusol™

- Cautions
  - May be negative in anergic individuals
  - May be false-negative in severe infections
  - Avoid in patients with erythema nodosum
  - Future immunosuppression may put skin test positive patients at risk

Wack et al. (2015) Clin. Infect. Dis. 61:787

Diagnostic modalities for Valley Fever

- Culture
- PCR
- Serology
- Antigen testing
- Skin testing
- Radiology

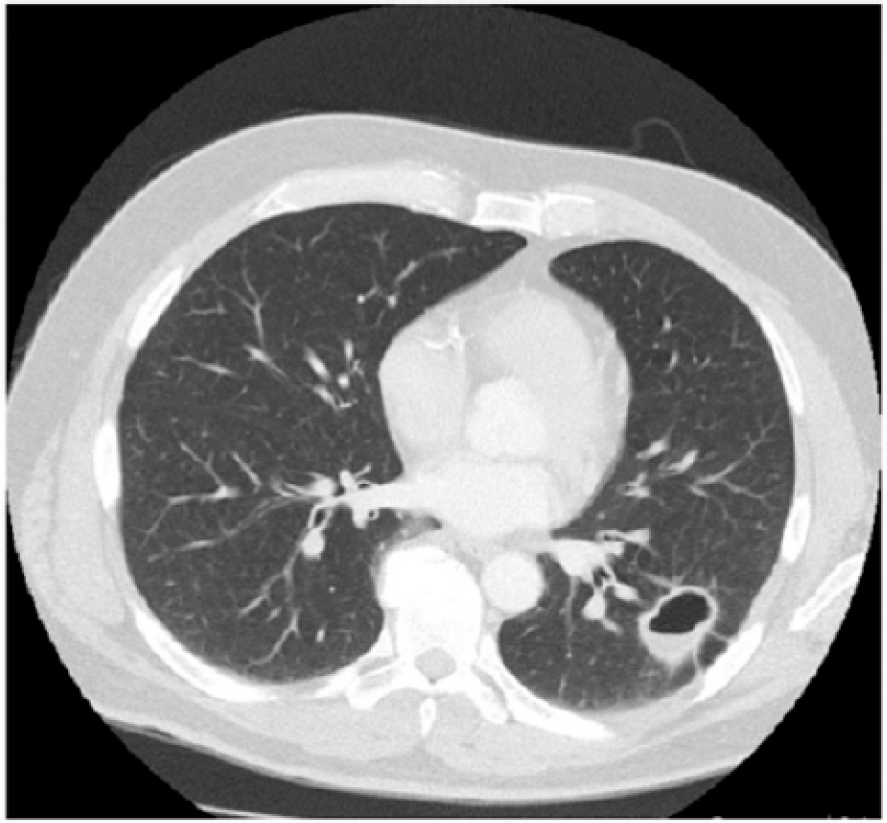
Radiology

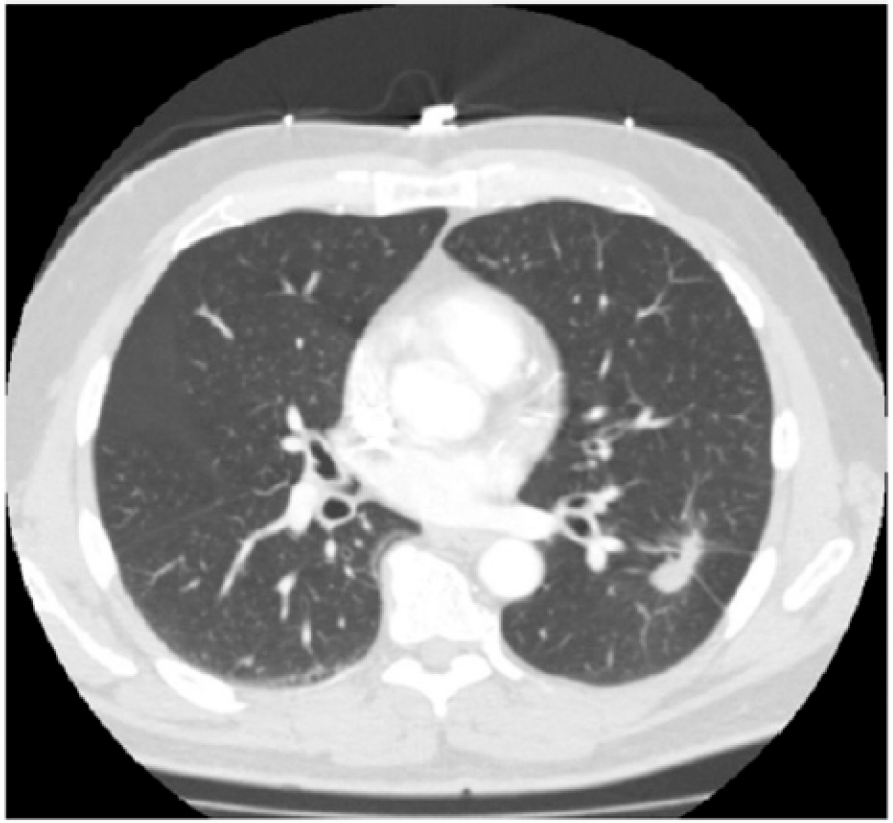
- Cavity (can mimic things like TB or other fungal infections)
- Nodule (can mimic cancer)
- Miliary (suggests dissemination)

Cavitary lesion (CT scan)

- Cavitary pneumonia

4 years later: nodule

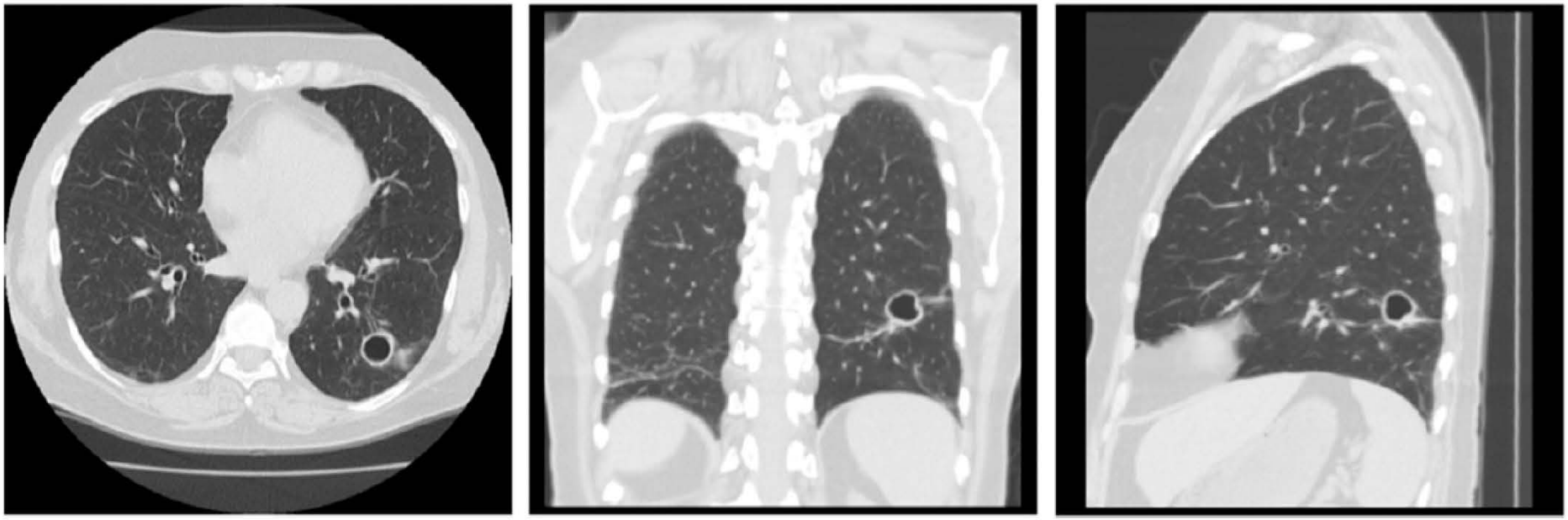




Malo et al. *Ann Am Thorac Soc* Vol 11, No 2, pp 243–253, Feb 2014

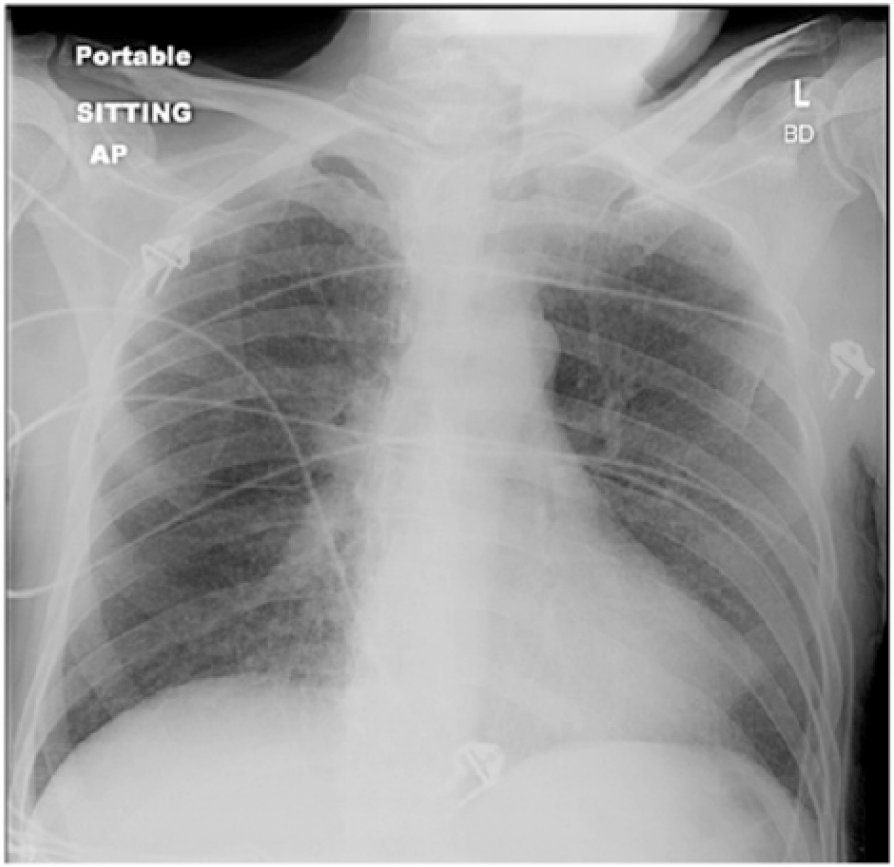
Cavity of coccidioidomycosis

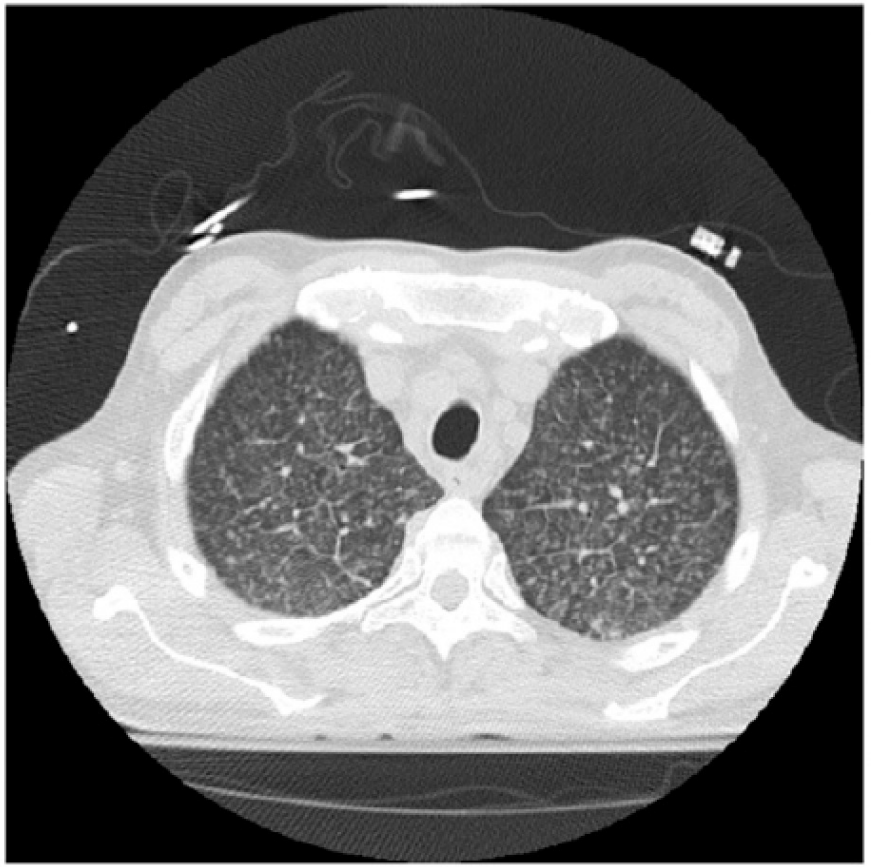
- Thin walled, typically not calcified



Malo et al. *Ann Am Thorac Soc* Vol 11, No 2, pp 243–253, Feb 2014

Immunocompromised patient: miliary pattern





Malo et al. *Ann Am Thorac Soc* Vol 11, No 2, pp 243–253, Feb 2014

Diagnostic modalities for coccidioidomycosis

Test	Turnaround Time	Evidence	Comments
Culture	Several Days	Direct	Requires good specimen
PCR	~48 hours	Direct	Cost, and requires good specimen, not clearly better than culture
EIA (IgG/IgM)	24 hours	Indirect	Serologic response can be slow and unreliable.
Complement Fixation (CF)	Several Days	Indirect	Quantitative. IgG only (chitinase) Serologic response can be slow and unreliable.
Immunodiffusion (IDTP = IgM) (IDCF = IgG)	Several Days	Indirect	Good specificity. IgG and IgM Serologic response can be slow and unreliable.
Histology	24 hours	Direct	Requires procedure for specimen collection
Spherusol	48 hours	Indirect	Skin test FDA cleared for verifying cellular immunity. Serologic response can be variable. Logistics
Imaging	24 hours	Indirect	Non-specific
Antigen Testing (MiraVista)	Several Days (sendout)	Direct	50-70% sensitive in urine & serum, cross reactive to other dimorphic fungi

A staged criteria
(expanded from EORTC)

Diagnosis	Spherules visualized or culture growth	Symptoms compatible with coccidioidomycosis	Radiographic abnormalities	Serology
Confirmed	+	+/-	+/-	+/-
Highly Probable	-	+	+	IgG or IgG and IgM positive
Probable	-	Presence of symptoms or radiographic abnormalities		IgG or IgG and IgM positive
Possible	-	Presence of symptoms or radiographic abnormalities		IgM only reactivity
Unconfirmed	-	-	-	IgM only reactivity

Case 1: 24 year old woman

- 1 week history of coughing up blood, Mild pain in chest (4/10 intensity)
- After 3 days admitted to outside hospital for evaluation
- L upper lobe cavity 21 x 18 mm, R lower lobe nodule 5 x 4 mm.
- AFB smears negative x3, Cocci negative IgG, IgM. Strep pneumo urine test was negative. Mycoplasma IgG was positive. Couldn't produce sputum in hospital, only when in shower.
- Sent home on oral Levaquin.
- Later that day presents to Mayo Clinic ED.

- Temperature of 36.3
- Heart rate 93, BP 120/79,
- Respirations 16, Sat 99%
- Hemoglobin of 12.9
- Hematocrit 38
- WBCs 8.1
- Platelets 216

Upon further questioning

- Blood streaked sputum 6 months prior
- Returned from Germany and Italy 2 weeks ago, with extensive European travel over past 2 years
- Occasionally coughing over past few weeks
- Also spent time in Wisconsin recently, where cough seemed to be better

Coccidioides testing

- Blood draw from ED sent for serology

Test	Initial draw
EIA IgM	Neg
EIA IgG	Neg
ID IgM	Neg
ID IgG	Pos
CF	Neg

- Could this be *Coccidioides*?
- Other causes for cavity in a traveler…

- Following day: bronchoscopy performed
  - Negative for Respiratory Pathogen Panel
  - 2+ respiratory flora
  - Grew 1 colony *Coccidioides*

- 2 weeks later, still hemoptysis on 800 mg Fluconazole, another bronchoscopy
  - 3+ respiratory flora
  - Grew 1 colony *Coccidioides*

- Wedge resection
  - Necrotizing granulomatous inflammation and organisms consistent with *Coccidioides*
  - Lung tissue grew 2+ *Coccidioides*
- 1 month after resection, feeling well.
- Serology:

Test	6 weeks after ED, 4 weeks post resection
EIA IgM	Neg
EIA IgG	Neg
ID IgM	Neg
ID IgG	Neg
CF	Neg

Case 1 pearls

- Sputum can be difficult to obtain
- Serology showed IgG by ID only
  - **Any positive serology in appropriate clinical context must trigger an investigation for coccidioidomycosis**
- Patient received a course of unnecessary antibiotics
- Infection refractory to treatment, required resection

Serology: it's great, except when it isn't

- EIA (results vary based on kit and prevalence)
  - 50% of patients positive at 2 weeks[1], 90% positive by 1 month[1]
  - Some studies question specificity[2]
  - Evaluation data vs. ID/CF or combined standard?
- ID
  - Best specificity
  - Least sensitive (75% overall)[1]
- CF
  - Great for following titer
  - Not as sensitive in early infection[1]
- Early treatment may blunt serologic response[3]

[1]Blair et al (2006) *Mycopathologia* 162(5): 317-324.
[2]Kuberski et al, *J Clin Micro* 48(6): 2047-2049.
[3]Thompson et al. *Clin Inf. Dis.* 2011:53 e20

Serology in immunocompromised hosts
(concept likely true for everyone)

Table 2. Seropositivity among 62 immunocompromised hosts with serologic confirmation of coccidioidomycosis detected by various serologic tests

Category of immunosuppression	Type of serologic testing, no. (%)							
	EIA (IgM and IgG)		CF		ID (IgM or IgG or both)		Any test	
	Tested	Positive	Tested	Positive	Tested	Positive	Tested	Positive
Hematologic malignancy (N = 14)	12	4 (33)	10	6 (60)	6	1 (17)	12	8 (67)
Cancer and chemotherapy, nonhematologic (N = 19)	18	13 (72)	18	12 (67)	15	9 (60)	19	18 (95)
HIV infection (N = 4)	4	1 (25)	3	2 (67)	3	2 (67)	4	3 (75)
Organ transplantation (N = 7)	7	5 (71)	6	2 (33)	3	0 (0)	7	5 (71)
Rheumatologic illness (N = 13)	11	9 (82)	10	6 (60)	8	4 (50)	11	10 (91)
Other ICH illness* (N = 11)	10	9 (90)	10	10 (100)	8	6 (75)	10	10 (100)
All patients†	57	38 (67)	52	35 (67)	40	21 (53)	58	49 (84)
Healthy patients tested ≤ 1 y after symptom onset (N = 261)	244	212 (87)	252	188 (75)	248	180 (73)	261	247 (95)

CF, complement fixation; EIA, enzyme immunoassay; ICH, immunocompromised; ID, immunodiffusion; HIV, human immunodeficiency virus.

*Patients with other causes of immunocompromise include 3 inflammatory bowel disease (1 taking infliximab), 2 autoimmune blood dyscrasias (hemolytic anemia and idiopathic thrombocytopenic purpura) taking prednisone, 1 autoimmune polyneuropathy, and 5 taking corticosteroids long-term for sarcoid, cough, other pulmonary diseases (chronic obstructive pulmonary disease, interstitial pulmonary fibrosis, or normal interstitial pneumonia).

†Six patients have 2 immunosuppressive illnesses and are represented in each category.

Mycopathologia (2006) 162: 317-324.

Summary

- Many useful modalities available, none are perfect
- If suspicious of coccidioidomycosis, considering ordering all serologic tests: EIA, CF, and ID
- Follow up on any positive serology in context of clinical symptoms
- New tools available: skin testing, antigen testing
- Immunocompromised hosts are complicated

Questions?

