

# Changing Urgent Care Patterns of Diagnosing Coccidioidomycosis in a Highly Endemic Urban Population



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## ABSTRACT

### BACKGROUND:

We found previously (Pu et al. Clin Infect Dis, 2021; PubMed 32511677) that only 0.2% of ICD10 codes for coccidioidomycosis (CM) in our health care system were associated with patients (pts) managed at an urgent care (UC) visit. Since 2020, during onboarding, at quarterly meetings, and in periodic emails, UC clinicians were encouraged to test for CM in patients with pneumonia (PNA).

### METHODS:

For 2018 through 2021, Banner Health UC System increased clinics from 41 to 48, clinicians from 89 to 193 (Nurse Practitioners, 49.2% ± 2%, Physician Assistants, 39% ± 2%, MDs/DOs 13% ± 1%), and total visits from 787 to 1,290 thousand. Average visits were 1.6 per pt. All UCs used a common electronic medical record (Cerner) during the study period. Data were downloaded in January 2022 to analyze UC clinician patterns of coccidioid serologic testing (CST, 98% were EIAs), CST results, and their relation to ICD10 codes.

### RESULTS:

For the study period, CST orders increased from 8.0 to 19.0 per 10,000 UC visits (chi-squared  $p < 0.001$ ). The percent of clinics testing >10 per year increased from 16% to 78%, and the percentage of clinicians testing increased from 37% to 67%. Percent positive CSTs were highest for August, November, and December (27.4%) and lowest from April through July (8.1%). PNA ICD10 codes (J18.9 or J18.1) were most frequently associated with positive CSTs (374 positive of 1,872 tested), and the ICD10 code for *Erythema nodosum* (EN, L52, 176 total pts) had the highest positivity rate (61.4%, 27 positive of 44 tested). Only 6 pts had both EN and PNA codes. As indicated in the table, testing of PNA pts over time increased on first visits, decreased on second visits, and increased on second visits when the first CST was negative. Testing also increased for EN pts. Despite these favorable changes, CST was still not done on over three quarters of pts where recommended.

### SPECIFIC CONCLUSIONS:

Routine quality improvement activities have significantly but only partially improved rates of testing pts with PNA or EN for CM in UC clinics located in an endemic area. Innovative strategies to change clinical practices may be needed to achieve greater success.

## RESULTS

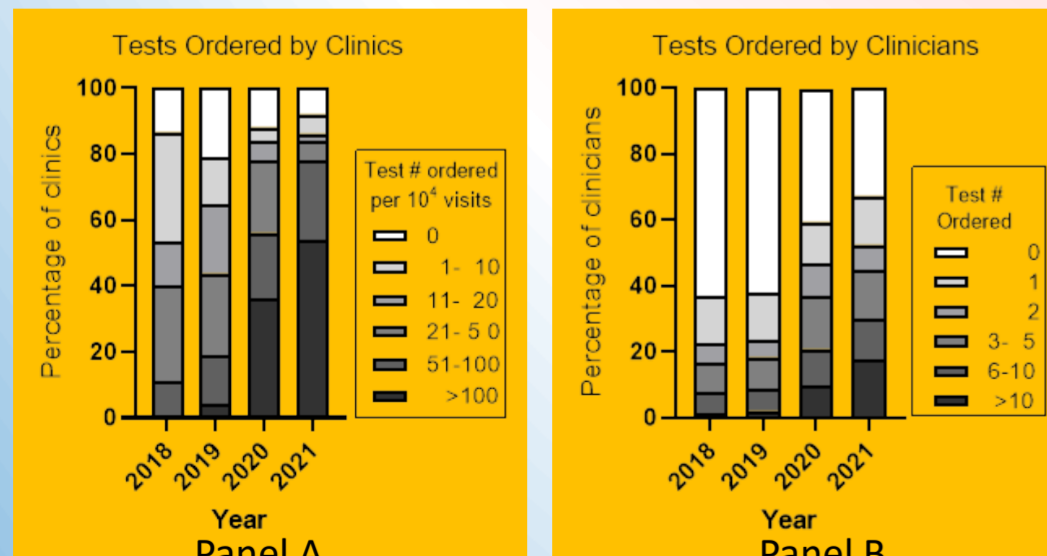
### Overall trends of BUCS testing practices.

- **Table 1:** With training, the number of coccidioid tests ordered increased.
- **Figure 1:** The changes occurred broadly across BUCS and all clinicians.
- **Figure 2:** The rate of ordering coccidioid tests during the study period varied no more than two-fold, but positivity rates were highest in August, November, and December.
- **Table 2:** ICD10 codes for pneumonia were the most frequently associated with positive tests. Also, *E. nodosum*-associated tests were positive 61.4%.

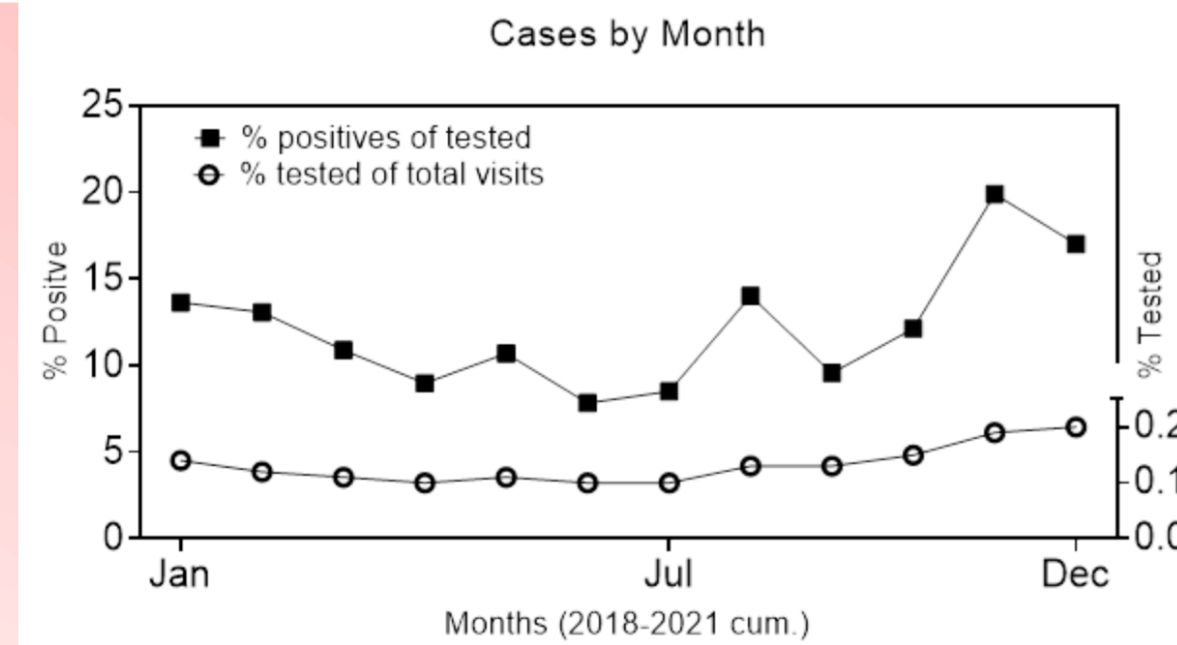
**Table 1. Overall changes in testing patterns by BUCS clinicians.**

Results	Years			
	2018	2019	2020	2021
Total BUCS visits*	373,272	413,968	592,678	697,523
Visits with coccidioid tests (per 10 <sup>4</sup> )**	5.5	6.7	15.7	19.8
Total BUCS pts	264,970	295,121	427,836	488,249
Patients with coccidioid tests (per 10 <sup>4</sup> )	7.8	9.4	21.7	28.1

Notes. \* Differences in visits between successive years:  $p < 0.0001$  for all three comparisons ( $\chi^2$  test).  
\*\* Differences in proportions between years of visits with testing for CM: 2018 vs 2019,  $p = 0.041$ ; 2019 versus 2020,  $p < 0.0001$ ; 2020 versus 2021,  $p = 0.0001$  ( $\chi^2$  test).



**Figure 1.**  
Panel A. Proportions of clinics ordering different numbers of tests. Differences in proportions between successive years: 2018 versus 2019,  $p = 0.679$ ; 2019 versus 2020,  $p < 0.001$ ; 2020 versus 2021,  $p = 0.042$  (Kruskal-Wallis).  
Panel B. Proportions of individual clinicians ordering different numbers of tests. 2018 versus 2019,  $p = 0.795$ ; 2019 versus 2020,  $p < 0.001$ ; 2020 versus 2021,  $p = 0.053$  (Kruskal-Wallis).



**Figure 2.**  
Frequency of testing for CM in all BUCS visits (open circles) and percentage of tests that were positive (closed squares) by month for the years 2018-2021.

**Table 2. Frequency of ICD10 codes for high association with positive coccidioid serologic tests and their frequency associated with those where coccidioid tests were ordered and all BUCS visits.**

Diagnoses and ICD10 codes	Positive tests (% of tested)	Tested visits (% of all visits)	All BUCS visits
Pneumonia J18.1, J18.9	187 (17.1%)	1,092 ( 8.8%)	12,364
Cough R05, R05.9	174 (13.0%)	1,342 ( 1.4%)	95,704
Fever R50.9	63 (15.1%)	416 ( 0.9%)	44,308
URI, bronchitis J06.9, J40, J20.9	46 ( 9.0%)	510 ( 0.2%)	219,232
Shortness of breath R06.02	44 (12.6%)	349 ( 1.4%)	25,374
Rash R21	33 (23.2%)	142 ( 1.1%)	12,877
<i>Erythema nodosum</i> L52	27 (61.4%)	44 (25.0%)	176
Chest pain R07.9	11 (18.0%)	61 ( 0.4%)	15,664

**Table 3:**

- Patients were older with pneumonia or with pneumonia and tested for CM ( $p < 0.0001$ ).
- Fewer females had pneumonia ( $p < 0.0001$ ) and were less frequently tested for CM ( $p = 0.027$ ).
- Pneumonia was less frequent in African Americans and Hispanic/Latin patients ( $p < 0.0001$ ).
- In other respects, testing for CM or the proportion of tests that were positive did not appear to be significantly different.

**Table 4:**

- The overall increase in testing of pneumonia patients parallels testing overall (Table 1).
- Testing for CM on a first visit increased as testing on the second visit decreased.
- In 2018-19, tests were done only on the first visit in 71 of 352 patients (20.2%), whereas in 2020-21, this rose to 1,105 of 1,513 patients (73.0%).
- Conducting a second test if the first test was negative also increased substantially and increased the number of patients who were found to have CM as the cause of their pneumonia.
- Year-to-year variation of CM as a percentage of all pneumonia patients tested ranged from 17.3% to 26.0%. in agreement with previous prospective Arizona studies .

**Table 3. Demographic characteristics of different groups of BUCS patients. Differences between the results in each of the four columns for age, percent female, or percent common race/ethnicity were where information was available.**

Characteristic	Without Pneumonia		With Pneumonia and Tested	
	Number of Patient	Tests Positive	Number of Patient	Tests Positive
Number of Patient	1,469,768	371	11,704	2181
Average age in years	44.8	49.6	54.0	50.4
% Female	60.0%	53%	54%	50%
Race/Ethnicity				
White/Caucasian	69.2%	70%	78%	75%
Hispanic/Latino	18.2%	14%	15%	14%
African American	5.5%	5%	4%	4%

Notes: Significance of differences in group ages was estimated by t-test and all other characteristics by test of proportions. For all characteristics, patients with and without pneumonia,  $p < 0.0001$ . The significance of other differences are described in the results.

**Table 4. Changes in testing patterns for CM in BUCS patients with pneumonia from the years 2018 through 2021.**

Groups	Years			
	2018	2019	2020	2021
All BUCS patients with pneumonia (J18.1, J18.9)*	2,094	2,565	3,473	3,558
Number of pneumonia patients (% of total) tested for CM**	150 (7.2%)	202 (7.9%)	732 (21.1%)	781 (22.0%)
1 <sup>st</sup> visit number tested (% positive)***	21 (29%)	45 (29%)	478 (20%)	543 (13%)
2 <sup>nd</sup> visit number tested (% positive)	129 (14%)	157 (18%)	254 (31%)	238 (16%)
Both visits number tested (% positive)	2 (100%)	3 (0%)	39 (41%)	45 (62%)
Percent of tested patients with positive tests (95% confidence intervals)	17.3% (10.8%-25.2%)	20.8% (14.6%-27.8%)	26.0% (20.3%-29.7%)	17.5% (14.5%-20.7%)

Notes. \* Differences in successive numbers of patients with Pneumonia:  $p < 0.0001$  for all three comparisons (Kolmogorov-Smirnov two sample Test).  
\*\* Differences between years in the proportion of pneumonia patients tested for CM: 2018 versus 2019,  $p = 0.30$ ; 2019 versus 2020,  $p < 0.0001$ ; 2020 versus 2021,  $p = 0.032$  ( $\chi^2$  test).  
\*\*\* Differences between years in the proportion of test for CM were performed on the first visit: 2018 versus 2019,  $p = 0.032$ ; 2019 versus 2020,  $p < 0.0001$ ; 2020 versus 2021,  $p = 0.059$  (test of proportions).

## Discussion.

- Increased training was associated with a significant increase in patient testing.
- Testing for CM was more frequent in older patients and provides a partial explanation for the age-related frequency of CM diagnosed in Arizona.
- That only 7.2% to 22.0% of pneumonia patients were tested for CM corroborates the preliminary CDC estimates of 6- to 14-fold CM underdiagnosis.
- Despite the improvement, over three-quarters of patients with CAP were not tested for CM. A probable reason is that clinicians are often trained outside of endemic areas, and they need to unlearn the treatment of CAP.
- Improving diagnostic practices for CM could serve to raise awareness about inappropriate prescribing for non-bacterial respiratory infections in general.
- Novel behavioral interventions might be fruitful approaches to improve compliance with the agreed upon clinical practice.
- Although *E. nodosum* is an infrequent diagnosis, overall positivity was 61.4% and independent of pneumonia.