87. Impact of State of Residence on Adult Vaccination Uptake: A Multilevel Modeling Approach

Shannon Hunter, MS[1]; Diana Garbinsky, MS[1]; Elizabeth M. La, PhD[1]; Sara Poston, PharmD[2]; Cosmina Hogea, PhD[2]; [1]RTI Health Solutions, Research Triangle Park, North Carolina; [2]GSK, Lancaster, Pennsylvania

Session: O-16. Current Issues in Public Health

Background: Previous studies on adult vaccination coverage found inter-state variability that persists after adjusting for individual demographic factors. Assessing the impact of state-level factors may help improve uptake strategies. This study aimed to:

- Update previous estimates of state-level, model-adjusted coverage rates for influenza; pneumococcal; tetanus, diphtheria, and acellular pertussis (Tdap); and herpes zoster (HZ) vaccines (individually and in compliance with all age-appropriate recommended vaccinations)
- Evaluate effects of individual and state-level factors on adult vaccination coverage using a multilevel modeling framework.

Methods: Behavioral Risk Factor Surveillance System (BRFSS) survey data (2015–2017) were retrospectively analyzed. Multivariable logistic regression models estimated state vaccination coverage and compliance using predicted marginal proportions. BRFSS data were then combined with external state-level data to estimate multilevel models evaluating effects of state-level factors on coverage. Weighted odds ratios and measures of cluster variation were estimated.

Results: Adult vaccination coverage and compliance varied by state, even after adjusting for individual characteristics, with coverage ranging as follows:

- Influenza (2017): 35.1–48.1%
- Pneumococcal (2017): 68.2–80.8%
- Tdap (2016): 21.9–46.5%
- HZ (2017): 30.5–50.9%

Few state-level variables were retained in final multilevel models, and measures of cluster variation suggested substantial residual variation unexplained by individual and state-level variables. Key state-level variables positively associated with vaccination included health insurance coverage rates (influenza/HZ), pharmacists' vaccination authority (HZ), presence of childhood vaccination exemptions (pneumococcal/Tdap), and adult immunization information system participation (Tdap/HZ).

Conclusion: Adult vaccination coverage and compliance continue to show substantial variation by state even after adjusting for individual and state-level characteristics associated with vaccination. Further research is needed to assess additional state or local factors impacting vaccination disparities.

88. Impact of a Computerized Clinical Decision Support Tool on clostridioides Difficile Testing and Oral Vancomycin Utilization as a Balancing Metric

Cory Hussain, MD[1]; Deborah Aragon, MSPH[1]; Bryan C. Knepper, MPH, MS[1]; Timothy C. Jenkins, MD[2]; Katherine C. Shihadeh, PharmD[1]; Heather Young, MD[1]; [1]Denver Health Medical Center, Denver, Colorado; [2]Denver Health Medical Center, University of Colorado School of Medicine, Denver, Colorado

Session: O-17. Diagnostic Stewardship

Background: Over diagnosis of hospital-onset *Clostridioides difficile* infection (HO-CDI) is directly tied to inappropriate *C. difficile* testing which does not distinguish between infected or colonized individuals. This can lead to inappropriate therapy. Multiple studies have utilized Computerized Clinical Decision Support (CCDS) tools to reduce inappropriate *C. difficile* testing. Our study looks at the impact of a Self-Assessment CCDS tools on *C. difficile* testing for HO-CDI and oral vancomycin utilization as a balancing metric.

Methods: Our institution utilizes a two-step test to diagnose HO-CDI that consists of toxin A/B enzyme immunoassay followed by a confirmatory PCR. We applied a self-assessment driven CCDS approach to reduce testing for HO-CDI. Our intervention was deployed in the 3rd quarter of 2018. It asked 3 questions about stool frequency, laxative use and previous *C. difficile* testing in the order itself. Inappropriate indications for testing included any of the following: < 3 bowel movements within 24 hours, receipt of a laxative within the past 48 hours, or a previous *C. difficile* test within the previous 7 days. Ordering providers would self-answer these questions. A 'yes' response to any of the three questions prevented further test ordering; though respondents had the freedom to change the answer and still proceed with the test order. We evaluated 3

metrics that were all calculated per 1000 inpatient census days: oral vancomycin usage, HO-CDI rates and *C. difficile* testing rates.

Results: Compared to baseline, our intervention resulted in a significant reduction of *C. difficile* testing and HO-CDI rates (Figure 1, Table 1). Oral vancomycin usage also decreased significantly (Figure 2, Table 1).

Figure 1. C. difficile testing and Hospital Onset C. difficile Infection Rates by Month, Before and After Intervention
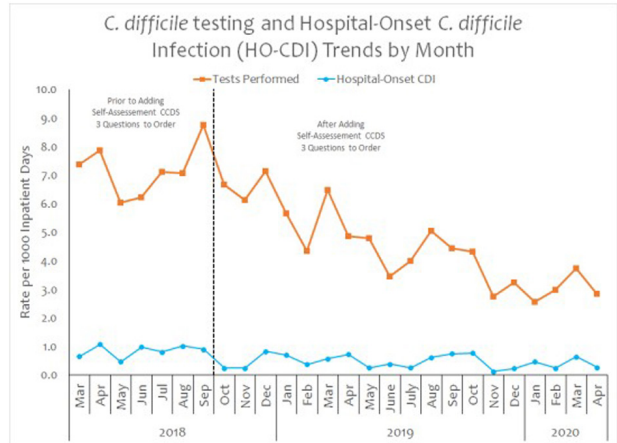

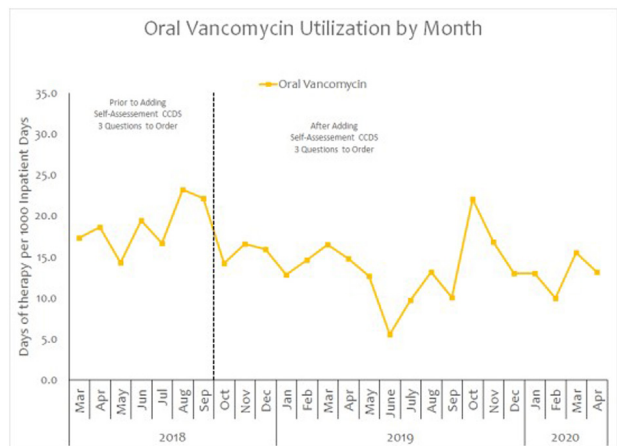Figure 2. Oral Vancomycin Utilization by Month, Before and After Intervention

Table 1. Changes in Median Rates of C. difficile testing, Hospital Onset C. difficile Infections and Vancomycin Utilization, Before and After Intervention.

	Prior to Adding Self-Assessment CCDS 3 Question to the Order	After Adding Self-Assessment CCDS 3 Question to the Order	P-value
Median C. Difficile Testing Rate Per 1000 Inpatient days (IQR)	7.1 (6.2-7.9)	4.4 (3.6-6.5)	0.004
Median HO-CDI Rate Per 1000 Inpatient Days (IQR)	0.9 (0.7-1.0)	0.4 (0.2-0.7)	0.007
Median Oral Vancomycin Days of Therapy Per 1000 Inpatient Days (IQR)	18.6 (16.7-22.1)	13.2 (12.7-16.0)	0.005

Conclusion: Our self-assessment driven CCDS-based diagnostic stewardship resulted in a significant reduction in inappropriate *C. difficile* testing for HO-CDI and HO-CDI rates. Oral vancomycin utilization as a balancing metric also decreased significantly. This was despite the use of a self-assessment driven approach with the freedom to change the answers in order to proceed with the test order.

89. Construction of an Electronic Algorithm to Efficiently Target Antimicrobial Stewardship Efforts for Adults Hospitalized with Community-acquired Pneumonia

Ebbing Lautenbach, MD, MPH, MSCE[1]; Keith W. Hamilton, MD[2]; Robert Grundmeier, MD[3]; Melinda M. Neuhauser, PharmD, MPH[4]; Lauri Hicks, DO, MPH[5]; Anne Jaskowiak, MS[1]; Leigh Cressman, MA[6]; Tony James, BA[1]; Jacqueline Omorogbe, MBE[1]; Nicole Frager, MPH[1]; Muida Menon, MS[3]; Ellen Kratz, BA[3]; Jeffrey Gerber, MD, PhD[3]; [1]University of Pennsylvania, Philadelphia, New York ; [2]Divison of Infectious Diseases, Philadelphia, Pennsylvania; [3]Children's Hospital

of Philadelphia, Philadelphia, Pennsylvania; [4]Centers for Disease Control and Prevention, Chicago, Illinois; [5]CDC, Atlanta, Georgia; [6]University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania

Session: O-17. Diagnostic Stewardship

Background: Although antibiotic stewardship programs (ASPs) have had success in curtailing inappropriate antibiotic use, they remain time- and labor-intensive. To expand the reach of ASPs, approaches to more efficiently target ASP efforts are urgently needed. We developed and validated an electronic algorithm to identify inappropriate antibiotic use in patients hospitalized with community-acquired pneumonia (CAP).

Methods: Within the Hospital of the University of Pennsylvania (HUP) and Penn Presbyterian Medical Center (PPMC), we used ICD-10 diagnostic codes to identify inpatient patient encounters for pneumonia between 3/15/17 – 3/14/18 for which patients received a systemic antibiotic in the first 48 hours of hospitalization. Exclusion criteria included transfer from another facility, intensive care unit admission or death in first 48 hours, immunocompromising condition, or specific comorbidities. We randomly selected 300 subjects (150-HUP, 150-PPMC). Inappropriateness of antibiotic use based on chart review served as the basis for assessment of the electronic algorithm which was constructed using only data in the electronic health record (EHR). Criteria for appropriate prescribing, choice of antibiotic, and duration of therapy were based on established hospital and IDSA guidelines.

Results: Of 300 subjects, median age was 60, 53% were female, and median hospital stay was 4.25 days. Of the 300 subjects, 237 (79%) were admitted to general medicine, hospitalist, family medicine, or geriatrics services. On chart review, 295 (98%) subjects were correctly diagnosed with CAP. Of these subjects, the choice of initial antibiotic(s) was appropriate in 263 (89%). Of these 263 subjects, 222 (84%) had an appropriate duration of therapy. Test characteristics of the EHR algorithm (compared to chart review) are noted in the *Table*.

Conclusion: An electronic algorithm for identifying inappropriate prescribing, antibiotic choice, and duration is highly accurate for patients hospitalized for CAP. This algorithm could be used to efficiently target ASP initiatives. The impact of interventions based on this algorithm should be tested in future studies.

Test Characteristics of Electronic Algorithm for Inappropriate Prescribing, Agent, and Duration

Test Characteristic	Value
Inappropriate Prescribing	
Sensitivity	100% (5/5)
Specificity	100% (295/295)
Positive Predictive Value	100% (5/5)
Negative Predictive Value	100% (295/295)
Inappropriate Agent	
Sensitivity	100% (32/32)
Specificity	96% (253/263)
Positive Predictive Value	76% (32/42)
Negative Predictive Value	100% (253/253)
Inappropriate Duration	
Sensitivity	100% (41/41)
Specificity	89% (190/212)
Positive Predictive Value	65% (41/63)
Negative Predictive Value	100% (190/190)

Disclosures: All Authors: No reported disclosures

---

90. Incidence and Risk Factors for Inappropriate Use of Non-culture Based Fungal Assays: Implication for Diagnostic Stewardship

Hiroshi Ito, MD[1]; Koh Okamoto, MD, MS[2]; Marie Yamashita, MD.[2]; Shinya Yamamoto, MD[2]; Yoshiaki Kanno, MD, PhD[2]; Daisuke Jubishi, MD, PhD[2]; Mahoko Ikeda, MD, PhD[2]; Sohei Harada, MD, PhD[2]; Shu Okugawa, MD, PhD[2]; Kyoji Moriya, MD, PhD[2]; [1]University of Tsukuba Hospital, Tsukuba, Ibaraki, Japan; [2]The University of Tokyo Hospital, Bunkyo, Tokyo, Japan

Session: O-17. Diagnostic Stewardship

Background: Culture-based diagnostic tests are the gold standard for diagnosing invasive fungal diseases (IFDs). Because these tests have low sensitivity, non-culture-based fungal assays (NCBFAs) have been used increasingly to help diagnose IFDs. However, little is known about inappropriate use of NCBFAs. We aimed to investigate inappropriate use of NCBFAs in a tertiary academic hospital in Tokyo, Japan.

Methods: This retrospective cohort study included all patients who underwent testing with beta-D glucan (BDG) between January and March 2018, or galactomannan antigen (GMA) or cryptococcal antigen (CRAG) between January and June 2018. Patients who had received hematopoietic stem cell or solid organ transplantations were excluded. Appropriateness was assessed according to the previously published study. We compared patients with appropriate and inappropriate use of NCBFAs. Risk factors for inappropriate use were evaluated using multivariate logistic regression analysis.

Results: Of 1,140 patients (BDG, 1,009; GMA 273; CRAG, 310) who underwent tests, 470 patients (BDG, 394; GMA, 138; CRAG, 164) were included in this study. Four hundred thirty-eight patients (93.2%) were aged 18 or older. About 80% of NCBFAs (BDG, 334 patients [74.8%]; GMA, 117 patients [74.8%]; CRAG, 146 patients [89.0%])

were deemed inappropriate. The factors associated with inappropriate NCBFAs use included specialties of ordering physicians, risk factors for fungal infections, and recommendation from infectious disease physicians (Table). Sixty-four patients (13.6%) underwent three inappropriate NCBFAs simultaneously. Furthermore, during the study period, 408 patients (35.8%) with inappropriate NCBFAs underwent the same assays repeatedly during the study period; 643 times for BDG, 163 times for GMA, and 192 times for CRAG.

The Factors Associated with Inappropriate Use of Non-Culture Based Fungal Assays

Beta-D glucan		
	OR	95%CI
Transplant medicine*	4.7	1.1–19.9
Neutrophil >500 / μ L	238	40.2–1,400
Use of enteral or oral nutrition	191	50.2–728
Without chronic obstructive pulmonary disease	13.1	2.6–66.3
Without high dose glucocorticoid† or immunosuppressants	7.7	2.7–22

Galactomannan antigen		
	OR	95%CI
Recommendation from ID physician	0.06	0.007–0.6
Without high dose glucocorticoid† or immunosupprsants	30	4.5–202

Cryptococcal antigen		
	OR	95%CI
Recommendation from ID physician	0.04	0.003–0.6
Without high dose glucocorticoid† or immunosuppressants	9.6	2.9–31.5

* Transplant surgery, hematology, and pediatric hematology
† ≥ 20 mg prednisone equivalents daily for four or more weeks
OR = odds ratio, CI = confidential interval, ID = infectious diseases

Conclusion: We found a large proportion of NCBFAs were deemed inappropriate and it was mostly driven by ordering physicians who generally care for transplant patients. Because inappropriate use of NCBFAs could lead to additional inappropriate tests and treatment with substantial costs to patients and health systems, diagnostic stewardship targeting NCBFAs is urgently needed.

Disclosures: All Authors: No reported disclosures

---

91. Development of an Electronic Algorithm to Identify Inappropriate Antibiotic Prescribing for Pediatric Otitis Media

Ebbing Lautenbach, MD, MPH, MSCE[1]; Jeffrey Gerber, MD, PhD[2]; Robert Grundmeier, MD[2]; Keith W. Hamilton, MD[3]; Lauri Hicks, DO, MPH[4]; Melinda M. Neuhauser, PharmD, MPH[5]; Nicole Frager, MPH[1]; Muida Menon, MS[2]; Ellen Kratz, BA[2]; Anne Jaskowiak, MS[1]; Leigh Cressman, MA[6]; Tony James, BA[1]; Jacqueline Omorogbe, MBE[1]; [1]University of Pennsylvania, Philadelphia, New York [2]Children's Hospital of Philadelphia, Philadelphia, Pennsylvania; [3]Divison of Infectious Diseases, Philadelphia, Pennsylvania; [4]CDC, Atlanta, Georgia; [5]Centers for Disease Control and Prevention, Chicago, Illinois; [6]University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania

Session: O-17. Diagnostic Stewardship

Background: Antibiotic stewardship (AS) interventions have primarily focused on acute care settings. The majority of antibiotic use, however, occurs in outpatients. The electronic health record (EHR) might provide an effective and efficient tool for outpatient AS. We aimed to develop and validate an electronic algorithm to identify inappropriate antibiotic use for pediatric outpatients with acute otitis media (AOM).

Methods: Within the Children's Hospital of Philadelphia (CHOP) Care Network, we used ICD-10 diagnostic codes to identify patient encounters for AOM at any CHOP practice between 3/15/17 – 3/14/18. Exclusion criteria included underlying immunocompromising condition, comorbidities, and concurrent infections that might influence antibiotic use. We randomly selected 450 eligible subjects (150 each from academic practices, non-academic practices, and urgent care). Inappropriate antibiotic use based on CHOP and professional society guidelines were assessed via chart review and served as the basis for assessment of the electronic algorithm which was constructed using only data in the electronic health record (EHR). Criteria for appropriateness focused on the decision to prescribe, the choice of antibiotic, and duration of therapy.

Results: Of 450 subjects, median age was 2, 46% were female, and 88% were evaluated by a physician (vs. advanced practice provider). On chart review, the prescribing decision was correct in 438 (97%), of which 25 appropriately received no antibiotics. Of the 413 subjects who were appropriately prescribed an antibiotic, the choice of antibiotic was appropriate in 37 (9%). Finally, of the 413 patients who were appropriately treated, 412 (99.7%) received the correct duration. Test characteristics of the EHR algorithm (compared to chart review) are noted in the Table.

Conclusion: For children with AOM, an electronic algorithm for identification of inappropriate antibiotic prescribing is highly accurate. This algorithm can also highlight for which elements of prescribing the impact of an intervention might be greatest (i.e., choice of agent). Future work should validate this approach in other health systems and geographic regions and evaluate the impact of an audit and feedback intervention based on this tool.

Table. Test Characteristics of Electronic Algorithm for Inappropriate Prescribing, Agent, and Duration