Impact of Viral Respiratory PCR and Serum Procalcitonin on Antibiotic Days of Therapy in Patients Admitted with Lower Respiratory Tract Infections

Anastasia Bilinskaya, PharmD[1]; Daniel Huang, PharmD[2]; Joseph L. Kuti, PharmD, FIDP[3]; Kristin E. Linder, PharmD, BCPS, BCIDP[1]

[1]Department of Pharmacy Services, [3]Center for Anti-Infective Research and Development, Hartford Hospital, Hartford, CT; [2]University of Connecticut School of Pharmacy, Storrs, CT

Introduction

- Lower respiratory tract infections (LRTI) are common reasons for healthcare visits in the United States, many of which are viral in etiology.[1]
- Differentiation between bacterial and viral respiratory infections can be challenging as clinical signs, symptoms, and radiologic findings are generally indistinguishable between the two etiologies.[2]
- Failure to diagnose viral respiratory infections can lead to inappropriate antimicrobial use, thereby increasing the risk of antimicrobial resistance.[3-5]
- Studies suggest upwards of 50% of patients receive antibiotics for a confirmed or suspected viral respiratory infection.[1,6]
- The Infectious Diseases Society of America (IDSA) advocates for the use of viral respiratory polymerase chain reaction (VRP), serum procalcitonin (PCT), or both to reduce inappropriate antibiotic prescribing.[7]
- These assays were implemented in our health system without formal antimicrobial stewardship intervention.

Objectives

- Assess VRP and PCT utilization in patients with a diagnosis of LRTI
- Evaluate the assays impact on total antibiotic days of therapy (DOT), hospital length of stay (LOS), 30-day readmission rates, and all cause mortality (ACM)

Methods

- Retrospective analysis across a five hospital health-system
- Hartford HealthCare (HHC) Institutional Review Board approved

Inclusion Criteria

- ≥ 18 years of age with no upper age limit
- Admitted between January 1, 2019 and January 31, 2019
- Admission to inpatient ward in any of the five HHC facilities
  - Hartford Hospital, MidState Medical Center, The Hospital of Central Connecticut, Windham Hospital, or Backus Hospital
- Diagnosis with the following ICD-10 codes associated with lower respiratory tract infections: J13-22, J44, or J85

Exclusion Criteria

- VRP or initial PCT ordered >48 hours from admission
- Active treatment prior to or during admission for concurrent bacterial or viral infections (apart from lower respiratory tract infection)

Endpoints

Primary Endpoints

- Total antibiotic days of therapy

Secondary Endpoints

- Hospital length of stay
- 30-day readmission rates
- All-cause mortality

Statistical Analyses

- Patients were categorized into five different groups based on diagnostic tests ordered: (1) VRP or PCT; (2) VRP and PCT; (3) Only PCT; (4) Only VRP; (5) Neither
- Continuous data comparisons:
  - Normally distributed data analyzed using a Student's t-test
  - Non-normally distributed data analyzed using a Wilcoxon rank-sum test
- Categorical data comparisons:
  - Analyzed using a Pearson chi-square test or Fisher's exact test
- Multivariate linear regression was used to determine variables associated with DOT
- Results yielding $p < 0.05$ were considered statistically significant

Results

- A total of 294 patients were included over 4 weeks of data collection
- 142/294 (48.3%) had at least one test ordered at the beginning of their admission
- The proportion of patients that had only a VRP, only a PCT, or both a VRP and PCT ordered were 15 (5.1%), 84 (28.6%), and 43 (14.6%), respectively
- These groups were assessed relative to control with no significant changes in endpoints
- Providers modified therapy based on final PCT and positive VRP results in 39.4% (50/127) and 33.3% (7/21) of patients, respectively (data not shown)

Table 1. Baseline Characteristics

Patient Characteristics	VRP or PCT (n = 142)	Control (n = 152)	P value
Age, years (median, IQR)	69.5 (56.0 – 79.3)	71.0 (61.0 – 82.0)	0.085
Male, n (%)	80 (56.3%)	78 (51.3%)	0.456
Caucasian, n (%)	98 (69.0%)	120 (78.9%)	0.070
Community admission, n (%)	139 (97.9%)	144 (94.7%)	0.265
Charlson Comorbidity Index (median, IQR)	1 (1 - 2)	2 (1 - 3)	0.157
Temperature, ° F (median, IQR)	98.5 (97.9 – 99.8)	98.3 (97.7 – 99.4)	0.216
White blood cell, n x 10^3 cells/mL (median, IQR)	9.35 (7.7 – 12.7)	10.5 (7.3 – 13.7)	0.373
Heart rate, bpm (mean ± SD)	92.5 ± 18.3	92.6 ± 17.9	0.976
Respiratory rate, rpm (median, IQR)	18 (18 – 22)	20 (18 – 22)	0.250
O_2 Saturation, % (median, IQR)	94 (93.0 – 97.0)	95 (93 – 97)	0.040
Chest X-ray (CXR) ordered, n (%)	141 (99.3%)	138 (90.8%)	0.002
Respiratory culture ordered, n (%)	78 (54.9%)	76 (50.0%)	0.466
Antibiotics ordered, n (%)	129 (90.8%)	131 (86.2%)	0.286

Results

Table 2. Primary and Secondary Endpoints

Endpoints	VRP or PCT (n = 142)	Control (n = 152)	P value
DOT, days (median, IQR)	7 (5 – 9)	7 (3 – 8)	0.159
Inpatient DOT, days (median, IQR)	4 (2 – 5)	3 (2 – 4)	0.001
Outpatient DOT, days (median, IQR)	2 (0 – 6)	3 (0 – 5)	0.628
Anti-pseudomonal (PSA) B-lactam (n,%)	38 (26.8%)	25 (16.4%)	0.044
Anti-MRSA antibiotics (n.%)	58 (40.8%)	48 (31.6%)	0.126
LOS, hours (median, IQR)	99.5 (73.5 – 163.6)	81.7 (57.8 – 115.2)	0.001
30 day readmission (n,%)	19 (13.4%)	23 (15.1%)	0.793
ACM (n,%)	3 (2.1%)	5 (3.3%)	0.794

Table 3. Multivariate Linear Regression Model

Variables	Multiplicative Effect	P value
Age	0.99	0.019
Length of stay (log)	1.21	0.008
Sepsis as primary diagnosis	1.08	0.353
VRP or PCT ordered	1.04	0.306
Intensive care unit (ICU) admission	0.70	<0.001
Positive CXR	1.17	<0.001
Receipt of anti-MRSA antibiotics	1.11	0.027
Receipt of anti-PSA B-lactam	1.12	0.037

Discussion

- Over the course of one month, VRP or PCT was ordered in nearly half of all admitted LRTI patients, but modification based on results was infrequent.
- Variables associated with increased DOT were younger age, length of stay, non-ICU admission, positive CXR, and receipt of anti-MRSA or anti-PSA antibiotics.
- The unrestricted use of these tests without stewardship intervention did not impact total antibiotic DOT, LOS, 30 day readmissions, or ACM.
- These data emphasize the importance of additional intervention to enhance the clinical utility of these tests.

References

1. Ebell M, Radke T. Antibiotic Use for Viral Acute Respiratory Tract Infections Remains Common. *The American Journal of Managed Care*. 2015;21(10):567-575.
2. Juvén T, Mertsola J, Waris M, et al. Etiology of community-acquired pneumonia in 254 hospitalized children. Pediatr Infect Dis J. 2000;19:293–8.
3. Musher DM, Roig IL, Cazares G, Stager CE, Logan N, Safar H. Can an etiologic agent be identified in adults who are hospitalized for community-acquired pneumonia: results of a one-year study. J Infect 2013; 67:11–8.
4. Musher DM, Thorner AR. Community-acquired pneumonia. N Engl J Med 2014; 371:1619–28.
5. Metlay JP, Kapoor WN, Fine MJ. Does this patient have com- munity-acquired pneumonia? Diagnosing pneumonia by history and physical examination. JAMA 1997; 278:1440–5.
6. Xu KT, Roberts D, Sulapas I, et al. Over-prescribing of antibiotics and imaging in the management of uncomplicated URIs in the emergency departments. *BMC Emergency Medicine*. 2013;13-7
7. Barlam TF, Cosgrove SE, Abbo LM, et al. Implementing an Antibiotic Stewardship Program: Guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America. Clinical Infectious Diseases. 2016;62(10):51-77. doi:10.1093/cid/ciw118.

Disclosures

Authors of this presentation have the following to disclose concerning possible financial or personal relationships with commercial entities that may have a direct or indirect interest in the subject matter of this presentation: Anastasia Bilinskaya: nothing to disclose; Daniel Huang: nothing to disclose; Joseph L. Kuti: nothing to disclose; Kristin E. Linder: nothing to disclose