Residency Project Pearls

Implications of a pharmacist co-managed discharge clinic on patient outcomes

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September 21, 2013

Conflict of Interest

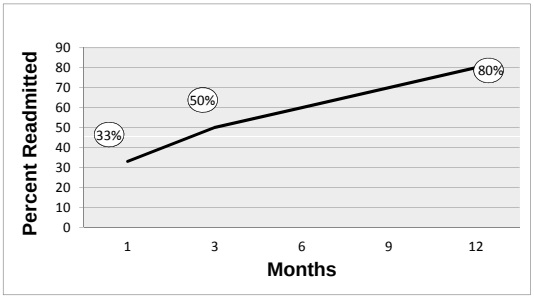
The speaker has no actual or potential conflict of interest in relation to this presentation

Unplanned Hospital Readmissions

- Defined as those which occur within 30 days of discharge
- Readmission rate estimates at University of Chicago Medicine (UCM)
  - 14.36% in 2012

Benbassat J, et al. Arch Intern Med. 2000; 160(8):1074-1081.
University Health System Consortium. University of Chicago Medical Center. 01/01/12 – 12/31/12.

Patients Eventually Readmitted



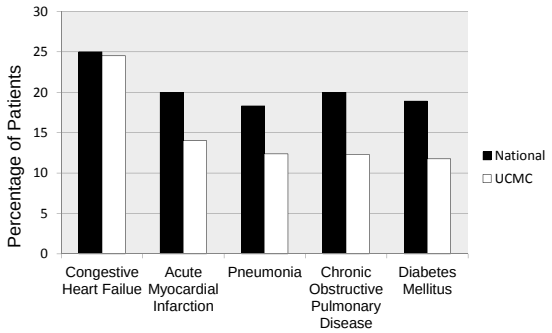
Horwitz L, et al. Centers for Medicare and Medicaid. 2011. https://www.cms.gov (accessed 16 Mar 2013).

Readmission Epidemiology

- Specific disease states have been linked to increased likelihood of 30-day readmission
  - Congestive heart failure, 16-25%
  - Acute myocardial infarction, 20%
  - Pneumonia, 18.3%
  - Chronic obstructive pulmonary disease, 20%
  - Diabetes mellitus, 18.9%

Axon RN, et al. JAMA. 2011; 305(5): 504-505.; Au, et al. Am Heart J. 2012 Sep; 164(3): 365-372.; Bradley EH, et al. J Am Coll Cardiol. 2012 Aug; 60(7):607-614.; Schmeida M, et al. Prof Case Management. 2012 May-Jun; 17(3):126-131.; Sharma G, et al. Arch Intern Med. 2010 Oct; 170(18): 1664-1670.; Chen Jym, et al. J Diabetes Sci Technol. 2012 May; 6(3): 563-571.

Readmission Epidemiology



University Health System Consortium. University of Chicago Medical Center. 01/01/12 – 12/31/12.

Readmission Preventability

- 13.3% of hospital readmissions may be potentially preventable
  - 2005 Medicare data
- Readmission rate preventability may range between 9 – 48%
  - Substandard inpatient care
  - Unstable therapy at discharge
  - Inadequate post discharge care

Benbassat J, et al. Arch Intern Med. 2000; 160(8):1074-1081.
Axon RN, et al. JAMA. 2011; 305(5): 504-505.

University of Chicago Discharge Clinic

- Physician and pharmacist co-managed
- Patients who have a UCM medical resident as their primary care provider
- Visit scheduled 1 – 2 weeks post discharge
- Patients are seen by both a UCM medical resident and a pharmacist
  - Medical resident is not necessarily the patient's primary care provider

Physician Responsibilities in Discharge Clinic

- Physical exam
- Follow-up with lab results and other test results from index hospitalization
- Order and follow-up with new lab test results ordered after discharge
- Arrange future follow-up
  - Primary care physicians
  - Sub-specialists

Pharmacist Responsibilities in Discharge Clinic

- Medication reconciliation
- Medication and disease state education
- Identification of medication-related issues
  - Medication access issues
  - Adherence
  - Adverse drug events
  - Evaluate overall treatment

Purpose

- Evaluate the impact of a healthcare provider visit closely following hospital discharge on patient outcomes
  - Readmission rates
  - Emergency Department (ED) visits

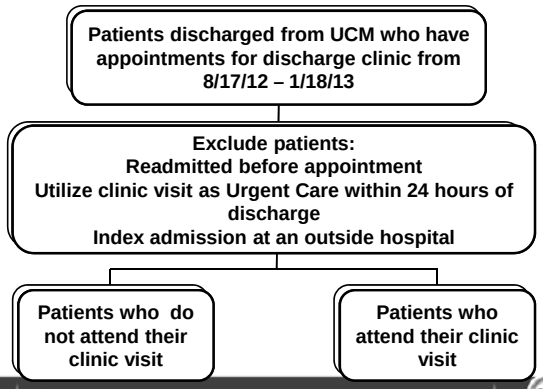
Hypothesis

- Patients who participate in the hospital discharge clinic will have fewer readmissions and ED visits than patients who do not attend their discharge clinic appointment

Study Design

- Single-centered, retrospective cohort analysis
  - University of Chicago Medical Center
    - 596 bed hospital
- Discharge clinic pharmacists logged interventions made during clinic appointments

Patient Selection



Endpoints

- Primary: Composite of readmission rates and number of ED visits within 30 days of hospital discharge
- Secondary:
  - Number of readmission and ED visits for same problem as index admission
  - Pharmacist interventions at discharge clinic visits
  - Adverse drug events (ADEs) identified at discharge clinic visits
- Subgroup Analysis: Characteristics associated with 30-day readmission

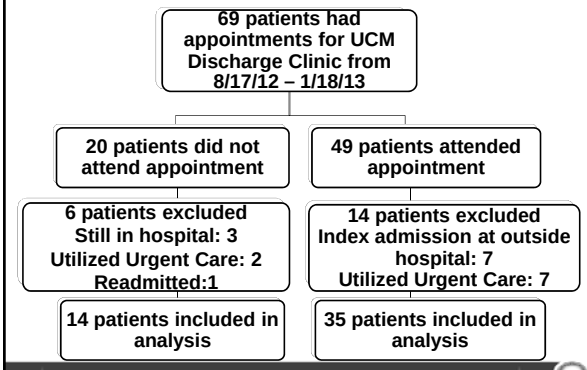
Statistics

- Readmission rates and ED visits within 30 days of hospital discharge and number of readmissions for same problem
  - Chi square
- ADEs and pharmacist interventions
  - Descriptive statistics
- Subgroup analysis
  - Logistic regression, multivariate analysis

Power Calculation

- To detect a 15% decrease in readmission rates from patients who do not attend discharge clinic compared to those who do attend
  - Sample size of 76 patients required in each group
  - To meet an 80% power
  - *a priori* alpha 0.05 set for statistical significance

Patient Enrollment



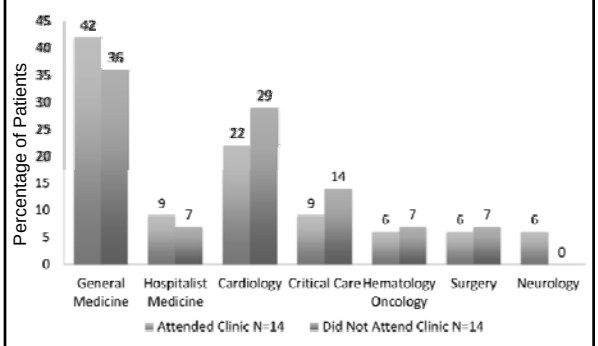
Patient Characteristics

	Did Not Attend Clinic N = 14	Attended Clinic N = 35
Age (years)	67 ± 17.1	68.3 ± 16.9
Male sex (%)	29	34
BMI (kg/m^2)	29.8 ± 6.4	29.6 ± 6.4
Medications prior to admission	12 ± 5	12 ± 5
Length of stay	5.4 ± 3.3	5.3 ± 3.3
Ambulatory days⌘	9.2 ± 6.6	8.5 ± 6.4

*Plus-minus values are means ±SD
⌘Ambulatory days: days between discharge and clinic visit

	Did Not Attend N = 14	Attended Clinic N = 35
Congestive heart failure	2 (14)	5 (14)
Pneumonia	1 (7)	2 (6)
Lung disease	2 (14)	2 (6)
Renal disease	0 (0)	3 (9)
GI bleed	0 (0)	4 (11)
Infection	4 (29)	5 (14)
Chest Pain	0 (0)	4 (11)
Adverse drug event	1 (7)	1 (3)
Stroke or TIA	0 (0)	2 (6)
Sepsis	1 (7)	1 (3)
Cardiac Disease	2 (14)	1 (3)
Other	1 (7)	5 (14)

Admitting Service



Medication Changes

	Did Not Attend N = 14	Attended Clinic N = 35
Prior to admission medications	12 ± 5	12 ± 5
Reliable documentation of discharge medications	**12**	**27**
New or changed medications at discharge	2.6 ± 3.5	2.5 ± 2.4
Home medications discontinued at discharge	3.5 ± 4.4	3.6 ± 4.3

*Plus-minus values are means ±SD

Primary Endpoint

	Did Not Attend N = 14	Attended Clinic N = 35	P value
Readmissions and ED visits at 30 days	5 (35.7)	8 (22.9)	0.357
Readmissions	2 (14.3)	6 (17.1)	0.807
ED visits	3 (21.4)	2 (5.7)	0.101

*All values displayed as number (%)

Number of Readmissions for Same Problem

	Did Not Attend N = 14	Attended Clinic N = 35	P value
Readmissions and ED visits at 30 days	5 (35.7)	8 (22.9)	0.357
Readmissions and ED visits for same problem	2 (40)	4 (50)	0.725

*All values displayed as number (%)

Subgroup Analysis

- Number of ambulatory days was associated with patients who were readmitted or presented to the ED in per protocol analysis
  - Odds ratio, 95% confidence interval
    - 0.731, 0.552 – 0.967
  - **P = 0.028**
- In intention to treat analysis, there were no significant associations with ambulatory days and readmission rates

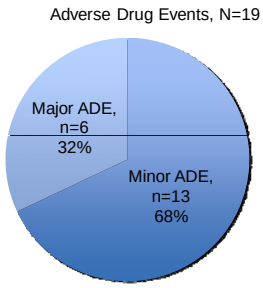
Pharmacist Interventions at Discharge Clinic Visits

	Attended Clinic N=41*
Patients seen by pharmacist⌘	33 (80.5)
Total pharmacist interventions	**102**
Interventions accepted by physician	99 (97)
Pharmacist interventions per patient§	3 ± 1.5

*Includes patients with index admissions at outside hospitals
⌘All values displayed as number (%)
§Plus-minus values are means ±SD

Pharmacist Interventions at Discharge Clinic Visits	Interventions N=102
Avoid Adverse Drug Event	19 (18.6)
Recommend New Therapy	11 (10.8)
Recommend Therapy Discontinuation	14 (13.7)
Recommend Monitoring	10 (9.8)
Recommend Dose Adjustment	3 (2.9)
Assist with Medication Access	5 (4.9)
Refill Request	8 (7.8)
Avoid Duplicate Therapy	3 (2.9)
Patient Education	16 (15.7)
Identify Condition without Medication	1 (1)
Drug Information	2 (2)
Recommend Vaccine	11 (10.8)

Adverse Drug Events Avoided at Discharge Clinic Visits



ADE – Adverse drug event

Limitations of Study

- Small cohort of patients likely representing a small national demographic
- Did not enroll enough patients to meet pre-determined power
  - Increased risk of Type II Error
- Dependence on discharge clinic pharmacists to see all patients and accurately log all interventions

Limitations of Study

- Patients referred to discharge clinic may represent a more acutely ill population
  - More likely to present to ED or be readmitted regardless of interventions made at clinic visit
- Inability to measure admissions or ED visits to outside hospitals unless documented
- Other measures taken by UCMC to reduce 30-day readmissions during index hospitalization may have confounded results

Implications on Current Practice

- Interventions made during clinic visits helped identify process improvements for inpatient setting
  - Discontinuing therapy
  - Patient education
  - Vaccine recommendations
- Increased number of ambulatory days was associated with primary endpoint
  - Demonstrates importance of having discharge clinic appointment soon after discharge
- Moving forward, will analyze financial impact of avoiding readmissions at UCMC

Conclusions

- It is unknown if attendance of discharge clinic reduced 30-day readmissions and ED visits
  - Clinic attendance did not impact readmissions for same problem
- Discharge clinic pharmacist was effective in implementing almost all recommendations during clinic visits
  - Including avoidance of 19 adverse events in 33 patients

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Post Test Question 1

- Congestive heart failure and pneumonia are diagnoses which are associated with a(n) _____.

a. Increased risk of 30 day readmission
b. Decreased risk of 30 day readmission
c. Similar risk of 30 day readmission compared to other diagnoses
d. Specific diagnoses do not impact 30 day readmission rate

Post Test Question 2

Which of the following is a potential cause for preventable hospital readmissions?

a. Substandard inpatient care
b. Unstable therapy at patient discharge
c. Inadequate post-discharge care
d. All of the above are potential causes for preventable hospital readmissions

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Residency Project Pearls

Therapeutic Drug Monitoring of Vancomycin in Stem Cell Transplant Recipients with Neutropenic Fever

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Illinois Council of Health-System Pharmacists
September 21, 2013

The Speaker has no actual or potential conflict of interest in relation to this presentation.

Objectives

- List the instances where vancomycin treatment would be appropriate to include as part of initial empiric antibiotic coverage for a stem cell transplant recipient who presents with neutropenic fever
- Discuss the side effect profile associated with vancomycin

Background: Neutropenic Fever

- >80% of patients with hematologic malignancies receiving chemotherapy experience fever
  - Fever may be the only marker of infection
  - Suppression of inflammatory mediators during chemotherapy
- Majority of neutropenic fever cases are culture negative
  - 20-30% of cases of result in a documented infection
- May be caused by gram negative or gram positive pathogens
  - Gram positive organisms currently more common

Freifeld AG, et al. *Clinical Infectious Diseases* 2011;52:e56-93.

Background: Neutropenic Fever

- Definitions
  - Neutropenia:
    - » Absolute neutrophil count (ANC) <500 cells/mm^3
    - » Anticipated ANC <500 cells/mm^3 within 48 hours
  - Fever:
    - » Single temperature ≥101° Fahrenheit
    - » Temperature ≥100.4° maintained for over one hour
- Empiric antibiotic coverage
  - Single agent with coverage of *Pseudomonas aeruginosa*
  - Additional agents based on suspicion of resistant organism presence

Freifeld AG, et al. *Clinical Infectious Diseases* 2011;52:e56-93.

Background: Vancomycin use in Neutropenic Fever

Vancomycin use is not recommended as part of the initial regimen for neutropenic fever unless:

1. Catheter-related Infection
2. Skin or soft-tissue infection
3. Pneumonia
4. Hemodynamic instability

Freifeld AG, et al. *Clinical Infectious Diseases* 2011;52:e56-93.

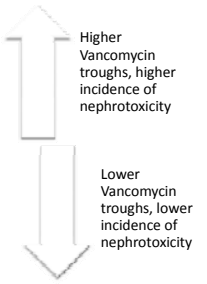
Background: Vancomycin Therapeutic Drug Monitoring

- Current vancomycin trough recommendation for neutropenic fever: 15-20 mcg/mL
- ASHP recommendation: Maintain troughs >10 mcg/mL
  - Goal: avoid development of resistant species

American Society of Health-System Pharmacists. *American Journal of Health-System Pharmacy* 2009;66:82-98.

Purpose

- No clear vancomycin trough goal guideline for stem cell transplant recipients with neutropenic fever
- Prior to 2009 guideline release, Northwestern Memorial Hospital (NMH) targeted lower vancomycin troughs
- Known safety risks associated with higher vancomycin trough levels



American Society of Health-System Pharmacists. *American Journal of Health-System Pharmacy* 2009:66:82-98
Van Hal SJ et al. *Antimicrobial Agents and Chemotherapy* 2013;57:734-44.

Purpose

The purpose of this study is to determine if there is a difference in efficacy with higher (≥10 mcg/mL) versus lower (<10 mcg/mL) vancomycin trough concentrations in stem cell transplant recipients with neutropenic fever.

Methods: Study Design

- Study is IRB approved at Northwestern Memorial Hospital
- Retrospective single center cohort study
  - Study site: Northwestern Memorial Hospital, Chicago, IL
- Patient population: Stem cell transplant recipients
- Time frame: August 2004 to March 2007
- Patient population identified via pre-existing database

Methods: Inclusion and Exclusion Criteria

- Inclusion Criteria
  - Fever ≥100.4° Fahrenheit within 24 hours prior to vancomycin start
  - ANC <1000 cells/mm^3 within 24 hours prior to vancomycin start
  - Meeting 2010 IDSA guideline criteria for treatment with vancomycin if empiric treatment OR gram positive documented infection if culture guided treatment
  - Overall receipt of vancomycin for at least 3 doses
  - Trough drawn after at least 2 doses of vancomycin
- Exclusion Criteria
  - Vancomycin therapy initiated prior to HSCT

Methods: Endpoints

- Primary Endpoint
  - Composite endpoint of resolution of SIRS criteria (heart rate, respiratory rate, temperature) and clearance of blood cultures
- Secondary Endpoints
  - Acute kidney injury
  - Mortality at discharge
  - Breakthrough infections

Which of the following is a situation in which vancomycin should be used as empiric treatment for neutropenic fever per IDSA guidelines?

A. Temperature >102 degrees Fahrenheit
B. History of gram positive infection
C. Hemodynamic instability
D. Hospitalization within the past three months

Vancomycin trough concentrations ≥15 mcg/mL have been associated with which adverse effect?

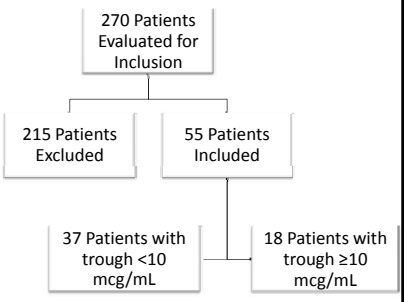
A. Hyperkalemia
B. Nephrotoxicty
C. Red Man Syndrome
D. Seizures

Methods: Definitions

Data Point	Definition
Resolution of Heart Rate (HR)	HR ≤90 beats/minute for ≥24 hours
Resolution of Respiratory Rate (RR)	RR ≤20 breaths/minute for ≥24 hours
Resolution of Temperature	Temperature ≤100.4° Fahrenheit for ≥24 hours
Vancomycin Trough Level	First trough level drawn during vancomycin administration
Acute Kidney Injury (AKI)	Serum Creatinine (SCr) increase of 0.5 mg/dL above baseline or 50% increase from baseline
Breakthrough Infection	Vancomycin susceptible growth from a bacterial culture drawn at least 1 day after vancomycin treatment initiation
Anti-pyretic Use	Receipt of at least 3 doses of APAP containing products during vancomycin administration timeframe

Results

- Chronological database review of stem cell transplant recipients at NMH starting in August 2004
- Sample size of convenience



Results: Baseline Characteristics

Characteristic	Trough <10 mcg/mL (n=37)	Trough ≥ 10 mcg/mL (n=18)	P-value
Female, n(%)	13 (35.1%)	9 (50.0%)	0.29
Age (Years), mean(±SD)	55.3 (±12.7)	56.3 (±10.0)	0.78
Weight (Kg), mean(±SD)	82.3 (±21.0)	80.6 (±17.0)	0.77
Positive Blood Culture Result, n (%)	17 (46.0%)	8 (44.4%)	0.92
Baseline SCr (mg/dL), mean (±SD)	0.92 (±0.24)	1.27 (±0.77)	0.01
Antipyretic Use, n(%)	21 (56.8%)	9 (50.0%)	0.64
Other Antimicrobials, n(%) - Antipseudomonal beta-lactam - Amikacin - Caspofungin	37 (100%) 2 (5.41%) 11 (29.7%)	18 (100%) 0 (0%) 8 (44.4%)	1.00 0.99 0.28

Results: IDSA Guideline Criteria – Empiric Treatment

Criterion	Trough <10 mcg/mL (n=37)	Trough ≥ 10 mcg/mL (n=18)	P-value
Catheter-related infection	1 (2.7%)	0 (0%)	0.99
Skin and soft tissue infections	1 (2.7%)	0 (0%)	0.99
Pneumonia	2 (5.4%)	0 (0%)	0.99
Hemodynamic instability	35 (94.6%)	18 (100%)	0.99

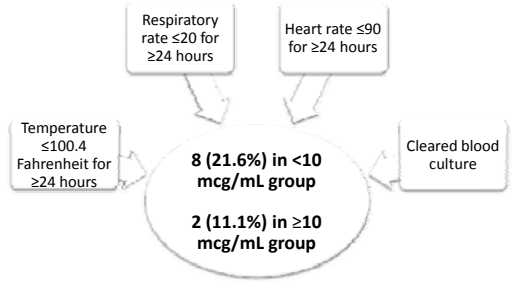
*Values represented are all n(%)
*Patients may have met multiple criteria

Results: Vancomycin Use and Monitoring

Characteristic	Trough <10 mcg/mL (n=37)	Trough ≥ 10 mcg/mL (n=18)	P-value
Dosing (mg/kg/day)	25.7 (±5.9)	23.5 (±8.4)	0.25
Number of doses prior to trough	4.2 (±3.6)	4.6 (±3.1)	0.76
Trough level (mcg/mL)	6.6 (±2.1)	17.5 (±6.2)	--

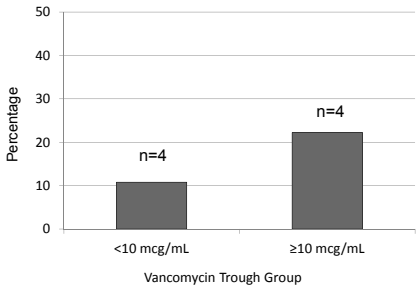
*Values represented are all mean (±SD)

Results: Primary Outcome



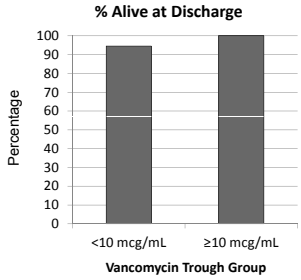
P= 0.47

Results: Secondary Outcome – Acute Kidney Injury



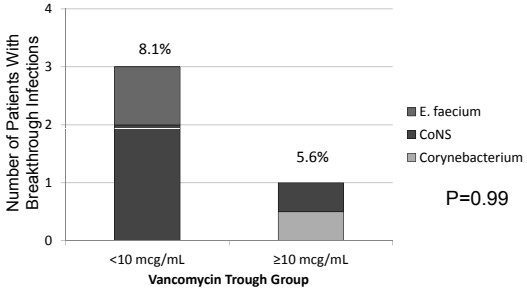
P=0.42

Results: Secondary Outcome – Mortality at Discharge



- <10 mcg/mL group: 2 deaths (5.4%)
  - 1 death: breakthrough VRE infection
- 10 mcg/mL group: 0 deaths (0%)
- P=0.99

Results: Secondary Outcome – Breakthrough Infection



P=0.99

Limitations

- Culture negative patients included in study
- Higher baseline SCr in ≥10 mcg/mL group
- Sample size of convenience
- Duration of treatment not analyzed

Conclusions: Overview and Future Directions

- Higher vancomycin troughs were not associated with increased efficacy in this study
  - Studies with higher power are needed to determine the true significance of this endpoint
- Future Interest Areas:
  - Breakthrough infection incidence and identity
  - Relationships between pre-vancomycin administration SCr, AKI, and vancomycin troughs

Conclusions: Impact on Practice

- Though this study did not show it, there a is known safety benefit to vancomycin troughs <15 mcg/mL with regard to nephrotoxicity
- Pharmacists may consider dose titration to the lower end of the currently accepted therapeutic range
- No recommendation to change practice may be made at this point

Van Hal SJ et al. *Antimicrobial Agents and Chemotherapy* 2013;57:734-44.

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Questions?

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Methods: Statistical Tests

- Baseline characteristics
  - Chi Squared or Fisher's exact for categorical data
  - T-test for continuous data
- Primary and Secondary Endpoint analysis
  - Fisher's exact for categorical data

Residency Project Pearls

Utilizing Procalcitonin Levels to Augment a Pharmacist Driven Antimicrobial Stewardship Program

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Disclosure

- The speaker has no actual or potential conflicts of interest
- This presentation will include discussion of an unlabeled or investigational use of a product that has not yet been approved by the FDA for the use being presented

Background

- Antibiotic over utilization is a challenge for healthcare systems, up to 50% is inappropriate
- 75% of antibiotic doses are for respiratory tract infections
  - Despite predominant viral etiology
- Key driver to increased drug resistance
- Drug toxicity
- Risk factor for secondary infections
  - *Clostridium difficile*-associated diarrhea

John JF, et al. Clin Infect Dis. 1997;24:471-85.
Hayashi Y, et al. Clin Infect Dis. 2011;52:1232-40.
Christ-Crain M, et al. SWISS MED WKLY.2005;135:451-460.

Procalcitonin (PCT)

- Produced in response to endotoxins or mediators
- Not elevated in response to viral infections
- Strongly correlates to the extent and severity of infection
- Promptly increases in 6-12 hours, peaks in 24 hours
- Levels decrease by half daily with controlled infection
- Unaffected by corticosteroids
- Relatively inexpensive and quick test

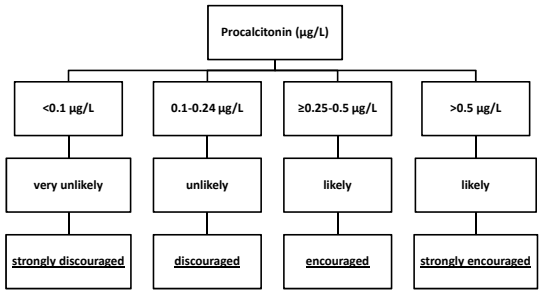
Schuetz P, et al. BMC Medicine. 2011; 9:107.

Limitations of Procalcitonin

- Newborns
- Major trauma/burns
- Cardiogenic shock
- Surgery
- Malaria and some fungal infections
- Treatment with cytokine stimulating agents
- Medullary thyroid carcinoma
- Localized infections

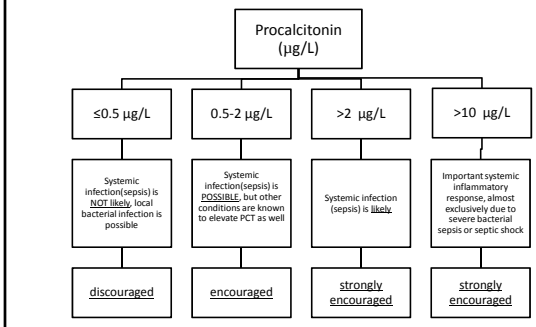
Christ-Crain M, et al. SWISS MED WKLY.2005;135:451-60

Lower Respiratory Tract Infections (LRTIs) Algorithm



Schuetz P, et al. ARCH INTERN MED.2011;171(15):1322-31.

Sepsis Algorithm



Christ-Crain M, et al. SWISS MED WKLY.2005;135:451-60

Mercy Medical Center

- Des Moines, IA
- Tertiary Care, Community Hospital
  - 802 acute care beds
  - On 3 campuses
- Pharmacist driven antibiotic stewardship program since 2000

Objective

- Determine if the addition of PCT levels to a pharmacist driven antimicrobial stewardship program could lead to a decrease in antibiotic utilization in patients on the medical floor with suspected sepsis and/or LRTIs

Methods

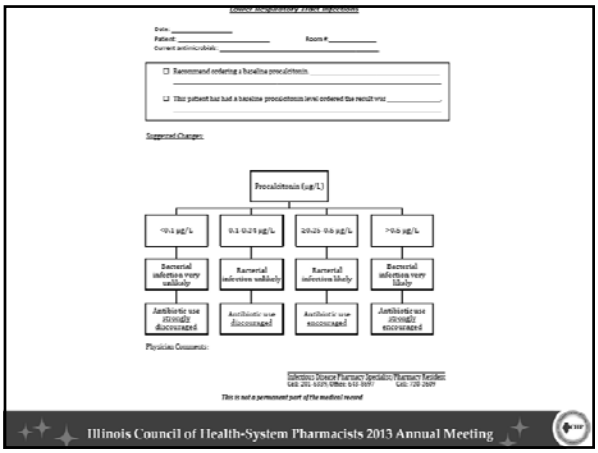
- Nonrandomized study at Mercy Medical Center
- Study population
  - Sepsis
  - Lower Respiratory Tract Infections
    - Community acquired pneumonia (CAP)
    - Healthcare associated pneumonia (HCAP)
    - Acute exacerbation of COPD (AECOPD)
    - Bronchitis
    - Asthma Exacerbation

Methods

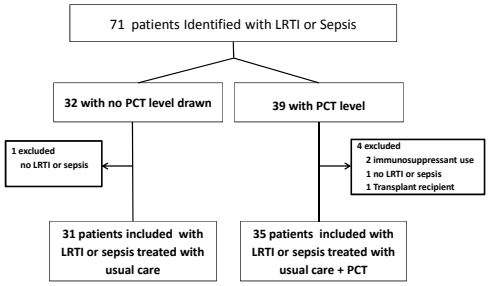
- Inclusion
  - ≥ 18 years old
  - Admitted to general medical floor for suspected sepsis and/or LRTI
- Exclusion
  - Pregnancy
  - CD4 count <200 mm^3
  - Lymphoid proliferative disorder
  - Neutropenia
  - Corticosteroids > 1 month
  - Immunosuppressant use
  - Chemotherapy
  - Transplant recipients
  - Trauma patients
  - Burn patients
  - Patients who had surgery
  - Cardiogenic shock
  - Cytokine stimulator use
  - Positive PCT level

Methods

- October 2012- Mercy IRB approval
- November 2012- physician education on PCT
- November 2012-February 2013- PCT algorithm chart notes added to the antibiotic stewardship program
- Daily list produced of all PCT test results



Patient Population



Endpoints

- Primary
  - Antibiotic exposure
    - Sum of each antibiotic ordered x duration of antibiotic therapy
      - Example: ceftriaxone 5 days & azithromycin 3 days =8 days
- Secondary
  - Frequency of follow up PCT
  - Cost

Statistics

- t-Test: Two-sample assuming equal variances
  - Age, WBC, Tmax, length of stay, cost, antibiotic day of exposure
- Chi-square
  - All other demographic information
- P-value <0.05 considered statistically significant

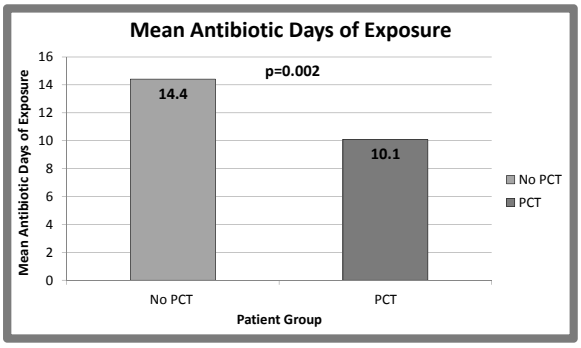
Baseline Characteristics

Characteristic	No PCT (n=31)	PCT (n=35)	p Value
Average Age, years (range)	75.3 (33,96)	73 (22,98)	0.57
Gender, female (%)	22 (71)	19 (54.3)	0.31
Diagnosis (%)			
CAP	12 (38.7)	14 (40)	0.51
HCAP	14 (45.2)	16 (45.7)	0.48
AECOPD	2 (6.5)	10 (28.6)	**0.044**
Bronchitis	4 (12.9)	5 (14.3)	0.87
Asthma Exacerbation	1 (3.2)	2 (5.7)	0.62
Sepsis	1 (3.2)	0 (0)	0.95
Comorbidities (%)			
CHF	11 (35.5)	15 (42.9)	0.71
COPD	11 (35.5)	13 (37.1)	0.88

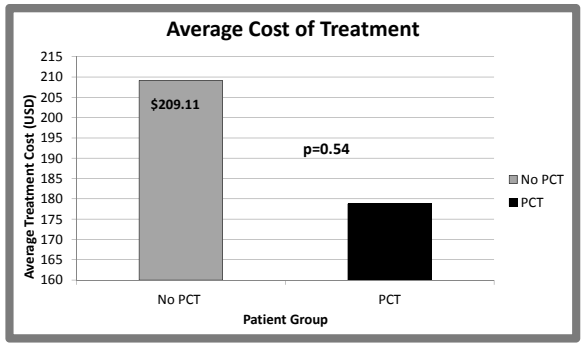
Baseline Characteristics

Characteristic	No PCT (n=31)	PCT (n=35)	p Value
Clinical finding (%)			
Mean initial WBC (k/mm^3)	10.9	10.2	0.50
Mean Tmax (°F), 1st 24 hours	99.1	99.3	0.64
Chills	10 (32.3)	5 (14.3)	0.14
Dyspnea	21 (67.7)	32 (91.4)	**0.035**
Cough	22(71)	24 (68.6)	0.83
Increased sputum	12 (38.7)	9 (25.7)	0.38
Influenza positive	5 (16.1)	9 (25.7)	0.51
Positive chest radiograph	9 (29)	11 (31.4)	0.83
30 - day readmission (%)	2 (6.5)	1 (2.9)	0.91
Mean length of stay (days)	7.3	6.2	0.31

Results



Results



Discussion

- Decreased antibiotic exposure when PCT was utilized
- No difference in the cost of treatment
- Only 11/35 patients with baseline PCT had a follow-up

Limitations

- Procalcitonin was ordered incorrectly as prolactin
- Temporarily ran out of the test
- Earlier interaction with PCT group
- Sepsis
- Small sample size

Conclusions

- PCT can aid in an antibiotic stewardship program
- More education for physicians
- Some reservation in the use of PCT
- New order sets or policies

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Utilizing Procalcitonin Levels to Augment a Pharmacist Driven Antimicrobial Stewardship Program

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Assessment Question 1

1. How can procalcitonin levels decrease the use of antibiotics in patients with suspected sepsis and/or lower respiratory tract infections?
   - A. It can determine the source of infection
   - B. It can determine if the infection is most likely bacterial or not
   - C. It can determine the appropriate length of treatment
   - D. It can determine the best antibiotic to use

Assessment Question 2

2. How can a procalcitonin level algorithm aid in antimicrobial stewardship?
   - A. The algorithm can allow for earlier antibiotic de-escalation
   - B. The algorithm can determine the appropriate length of therapy
   - C. The algorithm can be used to determine antibiotic selection
   - D. The algorithm can be utilized for all types of infections

References

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3. Christ-Crain M, Muller B. Procalcitonin in bacterial infections-hype, hope, more or less? Swiss Med Wkly 2005; 135:451-60.
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