Effect of a 3-Step Critical Pathway to Reduce Duration of Intravenous Antibiotic Therapy and Length of Stay in Community-Acquired Pneumonia

BACKGROUND:

- Patients who require hospitalization for community acquired pneumonia (CAP) consume a significant portion of economic resources compared to those who are treated outpatient.
- A large determinant of hospital length of stay (LOS) is the duration of IV antibiotic therapy and LOS is the most significant contributor to economic burden. In addition, a patient is at a greater risk of complications like phlebitis, pulmonary embolism, and other nosocomial infections the longer they are hospitalized.

OBJECTIVE

- To determine whether the use of a 3-step critical pathway is safe and effective in reducing duration of intravenous antibiotic therapy and length of stay in hospitalized patients with CAP.

METHODS

- **Design**: Randomized, control, parallel group study; Enrollment from May 1, 2005 to December 31, 2007.
- **Inclusion criteria**: Immunocompetent, 18 years or older, diagnosis of CAP (the presence of an infiltrate on chest X-ray plus one or more of the following: Fever (≥38.*C) or hypothermia (≤35.0*C), new cough w/ or w/o sputum, pleuritic chest pain, dyspnea, and altered breath sounds on auscultation).
- **Exclusion criteria**: Neutropenia (<500/uL), HIV, transplantation, immunosuppressant medications, and if they met 2 or more of the following: ICU admission from the ED, imminent death, shock, complicated pleural effusion (empyema or large effusion), pregnancy, aspiration pneumonia, severe social problems (e.g. homeless, drug abuse, severe mental disorders).
- **Primary outcome measure**: Hospital LOS measured in days from the admission date to date of discharge.
- **Secondary outcome measures**: Duration of IV antibiotics measured in days from the initial dose in the ED to the last dose, adverse drug reactions, hospital readmission within 30 days of randomization, death from any cause within 30 days of randomization, and the patient's overall satisfaction with their care during treatment for CAP.
- A total of 401 patients were stratified by hospital and into risk classes according to their Pneumonia Severity Index (PSI) score. Patients were then randomized with computer generated blocks of 10 with randomization code kept secret by the clinical epidemiologist in a sealed envelope. Patients who met criteria were randomized by the ID consultant who opened the sealed, sequentially numbered, opaque envelopes.
    - 200 in the 3-step critical pathway
    - 201 in the usual care pathway
- An estimated 380 patients were needed to achieve an 82% power at a 5% significance level to detect a 1.5 day difference in LOS between the 2 groups using a paired t-test.
- Data handling method was done using both intent-to-treat and per protocol.

RESULTS

- 378 patients of 401 completed the study
    - 13 dropped out of the 3-step critical pathway group
        - 1 was immunocompromised
        - 12 didn't have pneumonia
    - 10 dropped out of the usual care group because they did not have pneumonia

- **Primary outcome measure**: There was a -2.1 difference in LOS between groups (CI -2.7 to -1.7; $p<0.001$) with the mean of 3.9 days in the 3-step critical pathway group and 6.0 days in the usual care group.
- **Secondary outcome measures**: The median duration of IV abx was 2.0 days in 3-step critical pathway group and 4.0 days in usual care ($p< 0.001$). Adverse drug reactions occurred more frequently in the usual care group compared to the 3-step critical pathway group (15.9% vs. 4.5%; $p<0.001$) with phlebitis as the most common occurring reaction. Only 1 patient in each group was readmitted within 30 days of randomization for pneumonia. Treatment groups were equally satisfied with their treatment.
- **Author's conclusion:** The 3-step critical, which includes early mobilization, simple objective criteria for early determination for switch from IV to oral antibiotics, and for deciding hospital discharge is safe and effective at reducing duration of IV antibiotics and hospital LOS compared with usual care for CAP. Although there have been concerns that reducing hospital LOS would increase readmissions, this study showed that a 2 day decrease in LOS did not associate with greater readmissions or mortality.

STRENGTHS
- Stratification of patients based on PSI score.
- Handled patient data with both per protocol and intent-to-treat analyses.
- Inclusion and exclusion criteria allowed for extrapolation to the population of interest.

LIMITATIONS
- Statistical tests used to interpret some of the data were not the appropriate tests (i.e. paired t-test for LOS and power).
- Investigators were not blinded to the patients and physicians assigned to each group.
- Compliance with medication was not addressed in the study, which could have impacted readmissions.
- The study was not powered to detect survival or to look at the effectiveness of each step of the 3-step critical pathway.
- Specific difference in antibiotic use between the groups was not reported nor was the CAP treatment guidelines utilized at each hospital.

CONCLUSION
- Although the study found a decrease in IV antibiotic duration and LOS with no increase in readmission or mortality, I do not think based on this study alone that there is currently a role for the 3 step critical pathway in the hospital setting.
- Future Research:
    - Studies with a stronger design are needed to determine true efficacy of the 3-step critical pathway in treatment of CAP. For example, studies in which investigators are appropriately blinded to groups, utilization of appropriate statistical tests to analyze the data, larger sample size to achieve power to detect survival, and to evaluate the impact of each step in the 3-step critical pathway.

Reference: Carratalà J, Garcia-Vidal C, Ortega L, Fernández-Sabé N, Clemente M, Albero G, *et. al.* Effect of a 3-Step Critical Pathway to Reduce Duration of Intravenous Antibiotic Therapy and Length of Stay in Community-Acquired Pneumonia. Arch Intern Med. 2012 Jun 25;172(12):922-8.

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