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# Examination of IV antibiotic use and length of stay in community-acquired pneumonia patients

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Running head: IV ANTIBIOTICS

# Examination of IV Antibiotic Use and Length of Stay in Community-Acquired Pneumonia Patients

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Abstract

The purpose of this study was to examine the relationship between IV antibiotic administration and the length of stay for patients with community-acquired pneumonia. Research demonstrates that pneumonia is a large economic burden to acute care facilities across the United States. An ex post facto design was used to examine the difference in lengths of stay (LOS) for two groups of patients diagnosed with community-acquired pneumonia in the Appalachian region. The first group received IV antibiotic therapy at or within 8 hours of arrival to the hospital. The second group received IV antibiotic therapy after 8 hours of arrival to the hospital. All subjects in this study were at least 18 years old and admitted to the hospital for one or more days during the fiscal year 2000. Patients who were discharged within 14 days prior to admission were excluded from the study. Data were collected from 60 medical records randomly selected from 349 patients admitted for one or more days with pneumonia during the same year. An adapted version of the Medicare Quality Indicator System: Pneumonia Module was used to audit the medical records. All subjects in this study received appropriate IV antibiotics according to the Infectious Disease Society of America's guidelines. The mean LOS for each group was examined using an independent t-test. The retrospective ex post facto analysis revealed that the administration of IV antibiotics within 8 hours of arrival to the hospital does not significantly reduce LOS for this CAP sample ($p = .25$). Further investigation revealed that the nurses at this facility understand the importance of administering timely IV antibiotic therapy. This evidence is supported in that 77% of the study sample received appropriate IV antibiotic therapy within 8 hours of arrival to the hospital.

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# Chapter 1

## Introduction

This chapter will include the purpose of the study, hypothesis, definition of terms, background and significance, and the importance of the study for the nursing profession.

Pneumonia is an infection of the lower respiratory tract that is often caused by a virus, bacteria, or mycoplasma (Bartlett et al., 2000, American Lung Association, 2001). Community-acquired pneumonia as defined by Bartlett and colleagues (2000) is "an acute infection of the pulmonary parenchyma that is associated with at least some symptoms of acute infection and is accompanied by the presence of an acute infiltrate on a chest radiograph or auscultatory findings consistent with pneumonia and occurs in a patient who is not hospitalized or residing in a long-term-care facility for > 14 days before the onset of symptoms" (p. 348). According to Murphy, Noetscher, and Lagoe (1999) pneumonia accounts for over one-third of all respiratory related diagnoses, and makes up over 4% of all patients hospitalized today. Progressive pharmaceutical research has decreased the mortality rate for pneumonia patient by drastic numbers. However, the hospitalization costs for caring for patients with pneumonia continue to be high.

## Purpose of the Study

The purpose of this study was to examine the relationship between IV antibiotic administration and length of stay (LOS) for patients with community-acquired pneumonia in a non-profit community hospital located in the Appalachian region.

The focus of this research was on the use of LOS data from a nursing administration perspective and is not intended to provide specific implications for clinical practice. Clinical practice is recognized as a setting where human resources are utilized. This study seeks to evaluate where human resource utilization might be reorganized to account for better financial

accountability in the organization, and ultimately better patient care for the community. Nursing administration is concerned with resource consumption, and areas where human resources can be redistributed to ensure and improve quality of care. It is through quality of care efforts that each patient in the community receives maximum financial benefit. As much as 35% of resources provided to care for the CAP population are consumed by inpatient care (Dresser, L. D., Niederman, M. S., & Paladino, J. A., 2001). The author has identified community-acquired pneumonia (CAP) as one area of human resource utilization in which hospitals generally lose money due to extended lengths of stay.

## Hypothesis

The null hypothesis for this study was: There is no difference in length of stay between patients who are diagnosed with CAP and receive IV antibiotic therapy within 8 hours of arrival to the hospital and those patients who are diagnosed with CAP and receive IV antibiotic therapy after 8 hours of arrival to the hospital. The alternative hypothesis was: Patients who are diagnosed with CAP and receive IV antibiotic therapy within 8 hours of arrival to the hospital will have a shorter length of stay than patients who are diagnosed with CAP and receive IV antibiotic therapy after 8 hours of arrival to the hospital.

## Definition of Terms

Community-acquired Pneumonia. Community-acquired pneumonia was defined as patients who were admitted to the hospital for one or more days, were not discharged from the hospital within 14 days prior to admission, and had documented interpretations, by physician or radiologist, of a chest x-ray that confirmed the pneumonia diagnosis within 48 hours before or after arrival to the hospital.

IV Antibiotic Therapy. Appropriate antibiotics for hospitalized patients with community-acquired pneumonia are those classified as (a) cephalosporins, (b) macrolides, (c) β-lactam/β-lactamase inhibitors, and (d) fluoroquinolones (Bartlett, et al., 2000). The following antibiotics were investigated in this study: (a) cephalosporins - cefotaxime, ceftazidime, and ceftriaxone; (b) macrolides – azithromycin and clarithromycin; (c) β-lactam/β-lactamase inhibitors – ampicillin/sulbactam and piperacillin/tazobactam; (d) fluoroquinolones – ciprofloxacin and levofloxacin. The 8 hour interval for administration of IV antibiotic therapy was selected based on Bartlett and colleagues' recommendations that performance indicators for the treatment of CAP patients include the administration of antibiotic therapy within 8 hours of hospitalization (2000, p. 348). This performance indicator was further supported by Meehan, T. P, Fine, M. J., Krumholz, H. M., Scinto, J. D., Weber, & Fine, J. M. (1997) research findings that the administration of IV antibiotics within 8 hours of arrival to the hospital was associated with lower 30 day mortality rates of elderly patients with pneumonia.

Arrival. Arrival to the facility was defined as the first time documentation appeared on the medical record. This was usually found on the patient database upon arrival to the emergency department (ED) or the nursing unit. If the patient was admitted directly to the nursing unit then arrival time would be consistent with the time of admission. If the patient was admitted through the ED, the time of arrival will be earlier than the admission time due to time spent in the ED awaiting diagnosis and treatment.

Length of Stay. Length of stay was defined as the time between the date of arrival to the facility and the date of discharge from the facility. LOS was determined by subtracting the date of arrival from the date of discharge and reported in whole days (i.e. a patient discharged on 1/10/00 minus the date of arrival on 1/5/00 resulted in a LOS of 5 days).

## Study Variables

The independent variable was the administration of appropriate IV antibiotics within 8 hours of arrival to the hospital. The variable "time to administration of IV antibiotic therapy" was calculated by subtracting the time of arrival from the initial administration of IV antibiotics and was reported in hour and quarter-hour intervals. The dependent variable was the hospital length of stay for patients with CAP and was reported as number of days.

## Background and Significance

Pneumonia was the sixth leading cause of death and was ranked the number one infectious cause of death in the United States in 1998 (American Thoracic Society, 2001; Liebovitz, 2000). According to the National Center for Health Statistics ([NCHS]; 2000), pneumonia accounts for 90,147 annual deaths per year. Four-million eight-hundred thousand cases are reported annually and 1.3 million patients are seen in emergency departments. One million three hundred thousand patients are discharged from hospitals each year with a diagnosis of pneumonia (NCHS). A study conducted by Medicare determined that the administration of IV antibiotics within the first 8 hours of arrival reduced the death rate by 15% (Health Care Finance Administration [HCFA], 1997). These results support that early administration of IV antibiotics have a positive influence on the health outcomes of the CAP population.

Bartlett and colleagues (2000) report 2 to 3 million cases of CAP are reported each year, 500,000 of which are hospitalized. Therefore, CAP makes up as much as 63% of all pneumonia diagnoses and 38% of all hospitalized pneumonia patients.

The Health Care Cost and Utilization Project ([HCUP]; 2000) reported that the number of patient discharges from 1993 to 1997, for DRG 89 (simple pneumonia and pleurisy age >17 with complications) has increased from 600,000 to 700,000 per year. The individual cost for DRG 89

has remained essentially unchanged, from $9,566 to $9,941. As the volume increased, costs for treating patients assigned to DRG 89 have increased from $570 billion to nearly $700 billion per year. During the same period, the number of discharges per year for DRG 90 (simple pneumonia and pleurisy age >17 without complications) has fallen by 7,000, from 110,000 to 103,000, while the per-patient cost has remained relatively the same, $5,529 to $6,092. Costs for the DRG without complications ranged from $608 million to $627 million per year (HCUP, 2000).

The West Virginia Bureau of Public Health ([WVBPH]; 2000) reports the rate of pneumonia in West Virginia is similar (4%) compared to the rate of pneumonia in the United States (U.S. Census Bureau, 2000). In the county where this study was conducted, the rate of pneumonia (5%) was reported to be higher than the state of WV and the nation (WVBPH, 2000). Higher rates of pneumonia will ultimately cause greater financial burden for hospitals in this area. This further substantiates the need to serve this population as effectively and efficiently as possible.

## Importance of Study

Nursing Administration. Health care costs for pneumonia is approximately $700 billion per year and is an enormous financial burden to many organizations (HCUP, 2000). At the research setting, 349 patients were diagnosed with pneumonia during fiscal year October 1999 through September 2000. The net financial loss was $123,000. This represents a loss of $352 per patient per year. While it was difficult to determine the exact cause of the net loss, the researcher speculates that the LOS of this population was longer than necessary, thus consuming more financial and human resources than necessary for CAP patients' to return to clinical stability. Decreasing the length of stay for this population will help to reduce the costs of human and financial resources used for CAP. Resources not used for CAP as a result of improving

efficiency of care, can be reallocated to other areas of health services. The nursing administrator can use the results of this study to help educate the nursing and medical staff as to why timely administration of IV antibiotics for the CAP population is beneficial not only for the patient, but ultimately the community.

Nursing Practice. The prompt administration of IV antimicrobial therapy to patients with CAP may be lifesaving (Lynch, J., 2000). Nursing is ultimately responsible for the administration of IV antibiotic therapy and therefore plays an important role influencing LOS of the CAP population. This study is important to nursing practice because the results will provide evidence for the enhancement of patient care through timely administration of IV antibiotics for CAP patients. Kapoor concluded that improving efficiency of care, such as decreasing LOS, can be accomplished with CAP patients without affecting patient outcomes (1996). By decreasing the LOS of this population, nurses will reduce resource waste and increase efficiency for care to the CAP population. However, higher patient turnover will increase staff nursing workload (Hampson, 2000). With a decreased LOS of the CAP population, nurses will experience more frequent patient turnover rates that will result in increased workload due to the level of intensity that is required to admit and discharge patients. However, by decreasing the LOS and increasing patient acuity, the cost of care absorbed by the hospital will be reduced and allow for additional financial resources to provide better care for this population. Ultimately, the community will benefit from a hospital that can provide a broader spectrum of services due to reallocation of resources across the continuum of care.

More efficient and effective nursing practices will benefit the individual patient as well. Decreasing LOS benefits the patient financially by decreasing the charge for services not covered by third party payers. Decreasing the LOS will benefit the patient physically by

returning the patient to home where care is more optimal and healing occurs more quickly. The patient will benefit psychologically by reducing the stress and strains that result from extended hospitalization and being out of one's familiar home environment.

Research that measure outcomes of specific interventions, such as this study, also contributes to the practice of nursing from the perspective that nursing is a business that must take responsibility for providing effective and efficient services to the CAP population. This philosophy involves both the nurse administrator and the practicing clinical nurse. Awareness of the financial implications that result from clinical nursing practices and behaviors is important to providing a variety of services necessary for the community. To influence resource utilization, the nursing profession can assess its own actions regarding the timely administration of IV antibiotics, and begin to understand how this seemingly small contribution has an important influence on human and financial resource consumption. By understanding this outcome, the nursing profession will identify the CAP population as a consumer of significant human and financial resources and that those resources are drawn from a pool of shared resources that affect all other populations served.

Furthermore, this study is important to the nursing profession because it is the only study of its kind that has been conducted from the nursing perspective. During the literature review for this study, the investigator did not find any nursing research of this kind in the literature. The nursing literature has focused on outcomes of practice implementations such as guidelines, but has not specifically conducted research about what factors influence the costs associated with the CAP population. By investigating specific factors that influence the cost of hospitalization (such as timely IV antibiotic administration), nursing can contribute to the financial well being of the healthcare system and thus increase the quality of care provided to the people who they serve.

Patient Education. This study is important to patient educators because patient knowledge regarding the outcomes of timely administration of IV antibiotics for pneumonia will empower them to make better decisions about seeking treatment when signs and symptoms first occur. This knowledge will likely motivate patients to seek earlier intervention when signs and symptoms of pneumonia occur. Nathwani, Barlow, Rubinstein, & Davey (2001) state that reducing time elapsed between onset of symptom of CAP and initiation of treatment in the community will improve care to the CAP population. It will also provide patients practical information so that they will be more likely to expect a timely response from health care service providers upon arrival to the hospital.

As the costs of healthcare continue to rise, it is becoming more important to assess human and financial resource utilization in the hospital setting. Due to extended LOS and high consumption of resources, CAP is an important problem for investigation. The process of providing treatment and care to the CAP population must be broken down into its simplest form. By identifying areas where the CAP population consumes the most resources without evidence of effective outcomes, nursing can begin to evaluate better methods for care delivery. Nursing must identify how human and financial resources are used and make efforts to improve effectiveness and efficiency. By doing so, nursing can better serve the CAP population through measurement of treatment outcomes. Evaluation of treatment outcomes is one way nursing can help to reduce sky rocketing healthcare costs.

# Chapter 2

## Introduction

This chapter will provide research literature that supports the purpose of the study and a description of the theoretical framework follows.

## Literature Review

Feagan, B. G., Marrie, T. J., Lau, C. Y., Wheeler, S. L., Wong, C. J., & Vandervoort, M. K. (2000) study assessed the clinical practices and outcomes among patients with community-acquired pneumonia admitted to 20 Canadian hospitals. The setting was comprised of 11 teaching hospitals and 9 community hospitals across Canada. The study consisted of 858 hospitalized patients from 1,113 possible candidates who were screened for inclusion and exclusion criteria. Inclusion criteria consisted of patients being 18 years of age or older, having a diagnosis of CAP, and having a chest x-ray report consistent with the diagnosis. Patients were excluded if the medical record showed a history of hematologic malignant disease, organ transplant, tuberculosis, human immunodeficiency virus, cystic fibrosis, immunosuppressive therapy, or death that occurred during hospitalization.

The researchers did not reveal a study design, but the data were collected in a manner that employed a non-experimental, ex post facto design. Retrospective quantitative analysis of data from medical records was completed on patients meeting qualifying criteria. A registered nurse, who was unaware of the purpose of the study, reviewed each medical record based upon inclusion criteria.

The researchers used the pneumonia severity index (PSI) to measure the severity of illness for each patient. This instrument was established as a valid predictor of mortality in the pneumonia population (Feagan et al., 2000). The PSI instrument assigns a score from 1 to 5, where 1 and 2 are at low risk for death, 3 is at moderate risk, and 4 and 5 are at high risk for death. This result is based on the calculation of the patient's age, gender, nursing-home residence, co-existing diseases, physical

findings, and abnormal laboratory findings. The PSI score, demographic patient characteristics, and hospital sites served as the independent variables for the study. The dependent variable for the study was length of stay. Each of the independent variables was used to measure predictability for LOS for this population.

Multiple linear regression analysis was used to calculate predictability of variations in LOS based on the PSI value, hospital site, and patient characteristics. The result of this analysis showed that, collectively, these factors could predict 22% of the total volume for LOS. The researchers noted that this was consistent with Fine and colleagues' findings in a similar study complete in 1997 in the United States. Descriptive statistics were used to determine the median LOS of 7 days for all hospitals. The researchers did not report a mean for study LOS. The mean age was 69.4 and M PSI score was 105.0, which was classified as high-risk for mortality. Of the total sample, 61.9% were classified as high risk and 19.4% as low risk for mortality. Feagan and colleagues (2000) reported "the PSI class showed a positive correlation with all of the outcomes: patients with more severe disease were more likely to be admitted to an ICU, were at increased risk of death, and had a longer LOS" (p. 1416).

The researchers reported the median duration for IV antibiotic therapy varied by more than 3 days among hospitals. Seventy-nine percent of displayed patients IV antibiotic treatment was consistent with the American Thoracic Society's (ATS) guidelines for pneumonia. This includes the used of β-lactam and & or macrolidic IV antibiotic therapy which was noted to be the two most frequently used classes of IV antibiotics in this population. However, variation for compliance with these guidelines ranged from 47.9% to 100% across the study sample population. Feagan and colleagues' (2000) assert that this degree of variation provides a good "opportunity to reduce treatment costs by defining optimal clinical practices" (p. 1420).

Feagan et al. (2000) concluded that significant heterogeneity in LOS and clinical practices exists in this study population. The reason for the heterogeneity was not well understood. The authors realized the limitations for retrospective study in general, but felt that this study is accurate because of the highly objective endpoints. The research team suggested a randomized control trial that measured specific interventions such as increasing the use of oral antibiotics, by an earlier switch from IV antibiotic to oral antibiotics. They also suggested a randomized controlled research for determining the ability of the PSI to predict LOS and admission of patients diagnosed with pneumonia.

Schwartz, D. N., Furumoto-Dawson, A., Itokazu, G. S., Chinikamwala, M., Levasseur, S., & Weinstein, R. A. (1998) used a non-experimental descriptive design to evaluate the management and outcomes of CAP patients at a large, urban, public, teaching hospital. The objective of Schwartz and colleague's study was to "assess institutional performance of key diagnostic and therapeutic interventions and to identify areas amenable to improvement in the management of community-acquired pneumonia" (p. 195). The researchers employed a convenience sample of 50 patients admitted to the facility from 1994 through 1995. The sample was obtained by selecting patients from a list of descending last names until 50 eligible patients were found. Patients were included in the study if the medical record revealed possible or definite pneumonia as admitting diagnosis. Patients meeting the exclusion criteria if, less than 18 years of age, initially admitted the ICU, being hospitalized within 2 weeks of admission, receiving chemotherapy in the last 2 weeks, or having a WBC count <1000/cmm were excluded from the study sample.

The data were collected using retrospective medical record review of patients who met inclusion criteria. The researchers used the acute physiology and chronic health evaluation (APACHE

II), descriptive demographics, laboratory, clinical, and diagnostic tests, and a comorbidity index to evaluate the management and outcomes for the sample population.

The variables for the study were not explicitly defined, but can be inferred from the objective and purpose of the study. The independent variables were key diagnostic and treatment interventions. The dependent variable was length of stay for patients admitted to this facility with CAP during the period of investigation. The key diagnostic and treatment interventions included: (a) initial time of administration of antibiotics, (b) variation in antibiotic therapy, (c) type of chest x-ray, (d) variance in diagnostic opinion of emergency physician and radiologist, and (e) blood and sputum cultures. LOS was defined as the date and time of initial entry on the emergency department (ED) medical record or time of admission if the patient did not enter the system through the ED through the date of discharge.

T-tests were used to examine the continuous variables and chi-square was used to evaluate categorical variables. The mean LOS for this sample was 5.1 (SD = 3.0) days, and the mean time for initial antibiotic administration was 12.8 (SD = 9.9) hours. The researches found statistically significant reductions in time to antibiotic administration occurred when antibiotics were given in the emergency department ([ED] M = 5.5, SD = 3.1 hours) vs. the nursing unit (M = 16.1, SD = 13.7 hours, $p < .001$).

Schwartz and colleague's (1998) findings revealed most patients received third-generation cephalosporins or a β-lactam/ β-lactamase inhibitor during the initial course of treatment. The researchers expressed concern about 22% of patients received erythromycin (alone) because this does not cover an adequate spectrum for pneumonia patients. The researchers referred to the ATS guidelines for appropriate treatment of CAP patients. Schwartz et al. asserted, "timely treatment should reduce both the risk of complications and death, and should lead to a shorter length of stay and related hospital costs" (p. 197). The authors recognize three major limitation of this study: (a)

retrospective studies are subject to errors when recording clinical data; (b) abstracting physician interpretations of chest x-rays are weaker than review of the x-ray itself; (c) and that reliance on ICD-9 discharge codes are relatively unreliable. The researchers concluded that this study demonstrated the need for the hospital to develop standardized practice guidelines that are based on national guidelines.

In another study conducted by Ray, G. T., Collin, F., Lieu, T., Fireman, B., Colby, C. J., Quesenberry, C. P., Van Den Eeden, S. K., & Selby, J. V. (2000) determined the prevalence, average yearly cost per person, and the "percentage of total direct medical expenditures attributed to each of 25 chronic and acute conditions" (p. 92). The sample was made up of 2,076,303 members of the Kaiser Permanente (KP) health maintenance organization (HMO), located in Northern California during the fiscal years 1995 to 1996. Inclusion criteria for the study required that the subject be 18 years of age or older, enrolled as a KP client for any period during the time of study, and used the services of KP during the study period. In most cases, the diagnoses were determined by a single hospitalization or outpatient diagnosis. However, in the pneumonia cohort, the researchers reduced the sample by 29% to remove minor or doubtful cases. The exclusion included outpatient diagnoses that were not finally diagnosed in the emergency department or urgent-care clinic.

Ray and colleagues (2000) conducted a retrospective cohort analysis for all patients meeting the inclusion criteria. The Cost Management Information System provided cost data for services provided directly by KP. This system integrated hospital, radiology, laboratory, outpatient visit, and home health utilization databases to determine the costs of services provided directly by KP. For services not provided directly by KP, data was compiled from "databases that track all bills sent to KP from outside vendors for referral and claim activity" (Ray et al., 2000, p. 93). Data from pharmacy costs were obtained from databases that track all prescriptions at outpatient HMO pharmacies. It was

noted by the researchers that approximately 10% of members do not have the pharmacy benefit and therefore might not have used the HMO pharmacy systems.

The dependent variables for the study as identified by Ray and colleagues (2000) were total costs for each condition and prevalence of each condition. The independent variables for this study were (a) age, (b) comorbidities, (c) gender, (d) condition, and (e) average annual cost per patient. The researchers used ordinary least squares (OLS) regression to adjust for age, gender, and comorbidity. The additive model log transformation was used to model the costs in a form that reduced the skew of the distribution for the dependent variables. In order to estimate the generalization error, split sample validation tests were calculated. The results of these tests were not provided, only interpreted in order to define the process by which the investigators arrived at the conclusions. The researchers multiplied the average cost per person by the frequency of condition to determine the total amount contributable to each condition.

Ray and colleagues (2000) concluded that the most costly conditions per person per year were (a) renal failure ($22,136), (b) colorectal cancer ($10,506), (c) pneumonia ($9,499), and (d) lung cancer ($8,612). When the regression model was ran on the pneumonia cohort for those with 12 months of membership or who died during the study period, attributable costs increased by 10%. These changes were relatively small for the other cohorts in the study. When the regression model was ran on only those who were members for 12 months, costs attributed by pneumonia decreased by more than 10%. This suggests that patient death due to pneumonia tended to be more expensive in the pneumonia cohort than in others. The researchers found that ischemic heart disease and pneumonia account for 82% of total attributable costs related to hospital services.

Ray and colleagues (2000) expressed that this type of study was useful for identifying opportunities for alternative treatment models in order to develop a more cost effective system of care

(p. 98). The investigators discussed many limitations for the study. The researchers asserted that the most important limitation for this study was that it was based on KP's "method of case ascertainment and costing" (Ray et al. 2000, p. 100). Also noted was the study only included those who accessed the KP system for care, in other words the patients might be affected by their propensity to seek treatment. Patient's likelihood to seek treatment could influence the results if one is more or less likely to seek care for illness. Those subjects with a higher "propensity to use" are more pronounced in less severe conditions (i.e. headache, injury, or low-back pain, Ray et al. 2000, p. 101). The investigators suggested that this group warrants further investigation. The results of this study are more likely to reflect local practice patterns, since the sample was made up of Northern California members of KP.

Ramirez, J. A., Vargas, S., Ritter, G. W., Brier, M. E., Wright, A., Smith, S., Newman, D., Burke, J., Mushtaq, M., & Huang, A. (1999) examined (a) the proportion of CAP patients that could be switched to early oral antibiotic and then discharged, (b) the sample's level of satisfaction if discharged early, (c) evaluation of their clinical outcomes, and (d) factors that prevented early discharge when early antibiotic switch took place. The study sample included 200 consecutively hospitalized patients from December 1, 1994 through June 22, 1997. The researchers stated that subjects consented to participate in the study, and that no patient refused to participate. The study sample consisted of patients who had the presence of new pulmonary infiltrates and symptoms such as cough, fever or hypothermia, and & or leukocytosis or leukopenia.

Ramirez and colleagues (1999) conducted a prospective observational study of CAP patients recording the number of days required to switch to oral therapy and the LOS. For clients who reached clinical stability in 7 days, a retrospective review of medical records was conducted to determine a correlation between the severity of illness and number of days to clinical improvement was present. The research team intervened in the process of care only by insuring that those in the study received

IV antibiotics that were recommended by the ATS guidelines. The data were collected using the APACHE II severity of illness tool, post discharge clinic visits, post discharge telephone surveys, and other methods not clearly defined in the study.

The independent variable was the number of hospital days to conversion to oral antibiotics use. The dependent variable was LOS, clinical outcomes, and patient satisfaction with care if discharged early due to early switch to oral antibiotic therapy. Ramirez et al. (1999) found that 86% of the study sample reached clinical improvement within 7 days of IV antibiotic therapy. Of the total sample, 67% showed clinical improvement in 3 days, while 20% showed clinical improvement within 4-7 days of IV antibiotic therapy. The LOS for those reaching clinical improvement in 7 days was $\underline{M}$ = 4.8 days. The LOS for patients who were not subsequently treated for comorbidities, 44% of total sample, was $\underline{M}$ = 3.4 days. These patients who were not subsequently treated for comorbidities were optimal candidates for early switch and early discharge from the hospital. The LOS of those who were treated for comorbidities, 23% of total sample, was $\underline{M}$ = 7.6 days. The APACHE II score was significantly related to the number of days for clinical improvement ($\underline{p}$ <.001). Ramirez et al. considered the initial APACHE II score to be the best predictor for length of time to clinical improvement and patient switch to oral therapy. The investigators conducted a patient satisfaction phone survey that revealed 95% of patients who experienced early discharge due to early switch to oral antibiotics felt that the length hospitalization was appropriate.

Ramirez et al. (1999) concluded that LOS for a particular faction of patients diagnosed with CAP can be safely reduced using a regimen that implements early switch from IV to oral antibiotics and results in discharge from the hospital. The patients who benefited most from this intervention did not have comorbidities that needed treatment while admitted to the hospital. The investigators found that 95% of the sample didn't feel that they were discharged too soon and 98% were satisfied with

follow up care and were satisfied with the care they had received (p. 2451). The authors asserted that this study revealed a reduction in LOS for more than 2 days for 44% of the study sample. Ramirez and colleagues extrapolated financial data to reveal that as much as $397,320,000 could be saved annually in the United States if early switch to oral antibiotics that resulted in an early discharge of this population became a national standard.

In another study, Halm, E. A., Fine, M. J., Marrie, T. J., Coley, C. M., Kapoor, W. N., Obrosky, D. S., & Singer, D. E. (1998) described the time to clinical stability and clinical outcomes after reaching clinical stability in patients diagnosed with CAP. The authors measures of vital signs, ability to eat, and mental status as the variables by which the sample was determined to reach clinical stability. The sample consisted of 686 patients hospitalized in four New England hospitals. Patients were included in the study if they were 18 years of age or older, had signs and symptoms suggesting pneumonia, and had a positive chest x-ray for pneumonia. The longitudinal study was conducted from the 1993 to 1994.

This study was a part of a larger study on pneumonia conducted by the Pneumonia Patient Outcomes Research Team, that completed a "prospective, multicenter, observational study of outcomes in hospitalized and ambulatory patients with CAP" (Halm, et al. 1998, p. 1452). Halm and colleagues conducted daily chart reviews to assess patient clinical stability. The independent variables for this study were sociodemographic data, PSI scores, heart rate, respiratory rate, systolic blood pressure, temperature, oxygen saturation, and chest x-ray results. The dependent variable was clinical stability, that was defined as the first day that the five vital signs were within normal ranges and mental and eating status were stable.

Halm et al. (1998) used the Kaplan-Meier product-limit method to characterize time to individual clinical vital sign stability and overall stability. The PSI scores were stratified and analyzed for differences using log-ranked tests.

Halm and colleagues reported median scores for time to clinical stability as follows: (a) heart rate, (b) systolic blood pressure ≥90, and (c) ability to eat 2 days, and (d) temperature, (e) respiratory rate, (f) mental stability and (g) oxygen saturation 3 days. Seventy-five percent of the sample were clinically stable by day 3 based on heart rate, respiratory rate, systolic blood pressure, mental stability, and ability to eat (p. 1453). The researchers found difficulty in establishing a standard by which temperature could be defined as stable. Therefore, they defined a conservative temperature (Group A) as 37.2° C and a less conservative temperature (Group B) as 38.3° C. The overall median time to clinical stability for Group A was 5 to 7 days, while the overall median time to clinical stability for Group B was 3 days. The stratification of the PSI scores revealed that those classified as levels I, II, and III reached clinical stability sooner than those classified as levels IV and V.

Halm et al. (1998) found that 94% of the sample was treated with macrolides, second-generation cephalosporins, aminopenicillins, aminoglycosides, or natural penicillins within 24 hours of hospital admission. For all subjects, the median interval for conversion to oral antibiotic therapy after reaching clinical stability was 2-3 days. All subjects remained hospitalized a median of 4 days after reaching clinical stability. The investigators reported relapse in clinical stability after 1 day occurring in 25% to 45% of patients, and therefore suggested that observation for 24 hours after clinical stability may be reasonable when defining necessary hospital days.

The study by Halm and colleagues (1998) concluded that the average hospitalization of CAP patients may be safely shortened by using the time to clinical stability as a guide to making discharge decisions. The study recognized limitations such as the model of stability used might not be

considerate of all factors affecting LOS in the CAP population. The researchers noted that the study population tended to be younger and not as sick than the overall CAP population. The researchers recognized that the extent to which patients may have been adversely affected by being discharged at the point of clinical stability could not be established because patients tended to remain hospitalized after reaching clinical stability. The authors recommended prospective testing of explicit discharge decision rules based on this model be further studied "to ensure that a streamlined hospital course does not compromise patient outcomes" (Halm et al., 1998, p. 1458).

In summary, the literature described many components of the pneumonia population that are important to resource utilization. Feagan et al.'s (2000) study revealed that significant heterogeneity in LOS and clinical practices exists in their study population. The investigators reported that reasons for the heterogeneity was not well understood. Schwartz et al. (1998) showed significant variability in this population when they determined that the LOS for their sample was $\underline{M} = 5.1$ ($\underline{SD} = 3.0$) days, and the time for initial antibiotic administration was $\underline{M} = 12.8$ ($\underline{SD} = 9.9$) hours. Ray and colleagues (2000) concluded that pneumonia was the third most costly medical diagnosis in their population. The studies by Ramirez et al. (1999) & Halm et al. (1998) concluded that the CAP population could be safely discharged due to an early switch to oral antibiotic therapy. Decreasing the LOS will reduce excessive costs associated with CAP.

## Theoretical Framework

The General Systems theory is a grand theory conceptualized and developed by a biologist named Ludwig von Bertalanffy in the 1930s (Nunnery, 1997). Bertalanffy (1930) conceptualized that systematic processes could be attached to a common framework and transposed to other disciplines while maintaining its own essence. Much of the early developments of the general systems theory

was based on mathematical expressions but have since been applied to less logical and more abstract philosophies such as psychology and sociology. The General Systems theory is focused on "wholeness," as opposed to the details of the parts (Nunnery, 1997). This focus is based on the postulation that the whole is greater than the sum of the parts. This can be better understood by considering not only the parts of the system, but also the significance of the existing relationships within the system.

According to Nunnery (1997), the following principals define the General Systems theory: (a) Wholeness - the whole is greater than the sum of its parts. This requires that the parts and their relationships with each other and the environment be considered as one unit. (b) Hierarchy - a ranked series of the system's components, structures, and functions that occurs within the system. (c) Exchange of information and matter - a goal-oriented action that moves from the environment, through the systematic processes (throughput), and returns to the environment. (d) Progressive differentiation - a process of isolating parts or subgroups that results in self-organization. (e) Equifinality - arrival at the same outcome from different starting points. (f) Teleology - a purposeful, goal directed behavior within the system.

The application of general systems theory can be described and visualized through five basic elements: they are input, throughput, output, feedback, and the environment. Input is the current state of the existing part that enters the throughput of the system (Nunnery, 1997). Throughput is the process of influencing the input in an effort to change the part and produce the output (Nunnery). Output is the result of the system's influence on the input (Nunnery). Feedback examines the output to evaluate the changed part and determine how the system might change its influencing properties in order to produce a better output in the future (Nunnery). The environment exists within the system (throughput), as well as surrounding the system (inputs, outputs, and feedback; Nunnery).

The investigator has utilized the General Systems theory to provide the underpinning for describing the quality of care as related to resource utilization and one component that contributes to it, effective and efficient treatment of the CAP population. Wholeness can be related by considering the quality of care as an encompassing body of influential processes that function interdependently to provide healthcare for the community. Hierarchy can be applied to the quality of care by breaking down different processes that occur within. For example, the hierarchy of the CAP population can be constructed in descending order in the following manner: (a) quality of care, (b) resource utilization, (c) cost of care, (d) LOS, (e) nursing care actions and medical treatment orders, (f) medical diagnosis, and (g) patient arrival. The exchange of information and matter occurs at each level of the hierarchy, but medical treatment orders and nursing care actions was of particular interest during this research study. Progressive differentiation helps ground the research by identifying and organizing the factors that have an impact on LOS for patients with CAP. Equifinality is then connected by acknowledging that many other processes such as medical and nursing skills, quality and timeliness of x-ray, and social factors related to discharge are areas that could be evaluated and improved upon in order to decrease the mean LOS. Teleology is related in that the research is a purposeful behavior that provides information about one factor of treating the CAP population.

Nunnery (1997) states "systems theory provides a useful framework to visualize some phenomena (the system), focusing on the components, structure, and functions as the internal environment (throughputs), and influenced by (inputs and feedback) and influencing (outputs) the environment." This system can be visualized by the use of the five basic component of the general systems model (Figure 1). The input is the patient's arrival from the external environment to the internal environment (throughput) where treatment occurs. The output is the patient being discharged from the hospital (throughput) and returning to the external environment. The role of the researcher is

to compare the mean LOS of two groups of outputs. By doing so and sharing conclusions with the nurse administrator, the researcher serves as a feedback mechanism. The two groups of outputs are those patients treated for CAP who did receive IV antibiotics within 8 hours of arrival and those who did not receive IV antibiotics within 8 hours of arrival. The results of this comparison will provide measured information for the hospital (throughput) to help determine if timely administration of IV antibiotics to the CAP population is a single valid point for improving resource utilization.

# Chapter 3

## Introduction

The research design and methods will be described and the methods section will include the sample and setting of the population, instrument used to collect the data, procedures for conducting the research, limitations of the study, recommendations for future research, and a timeline for the project.

## Design and Methods

Design. An ex post facto design was used to complete a comparative analysis of IV antibiotic therapy and length of stay for patients with community-acquired pneumonia.

Sample and Setting. The sample included patients diagnosed with community-acquired pneumonia and admitted to a non-profit community hospital for one or more days during the fiscal year October 1999 through September 2000. Three hundred forty-nine patients were identified as being eligible for the study based on diagnostic related groups (DRG) 89 or 90. A total of 60 patients comprised of two groups of 30 were randomly selected from medical records. Group 1 comprised of patients who received appropriate IV antibiotics at or within 8 hours of arrival to the facility. Group 2 comprised patients who received appropriate IV antibiotics after 8 hours of arrival to the facility.

Inclusion criteria consisted of patients who were: (a) 18 years or older, (b) diagnosed with community-acquired pneumonia (CAP), bacterial pneumonia, or pneumonia, (c) had a chest x-ray 48 hours before or after admission to the hospital that was reported consistent with pneumonia, and (e) a DRG reference number 89 or 90. The chest x-ray was consistent with pneumonia if the report read pneumonia, air bronchogram, air space disease, consolidation, infiltrate, inflammation, opacity, or pneumonitis.

Patient exclusion criteria were: (a) those who were re-admitted to the hospital within 14 days of previous discharge, (b) evidence of chemotherapy within 60 days, or (c) history of organ transplant, (d) tuberculosis, (e) HIV, (f) AIDS (these patients were excluded because they were more likely to represent pneumonia that was the a result of immunocompromise as opposed to being community-acquired); and (g) patients who had documented orders for "comfort care only," had died, had been discharged on the day of admission, or had left against medical advice were excluded since their actions or individual situations clearly influence their length of stay.

Instrument. A medical record audit tool was used to collect data (Appendix A). This tool was an adapted version of the Medicare Quality Indicator System (MQIS) Pneumonia Module (1999). MQIS is a standardized data collection system developed to assess the quality of care for hospitalized patients with specific clinical conditions. The Health Care Finance Administration of the United States of America selected the Connecticut Peer Review Organization (CPRO) to develop the pneumonia module in 1994. CPRO completed extensive literature searches and validated information with local clinicians and national experts. Representatives from the American Thoracic Society, Infectious Diseases Society of America, and Pneumonia Patient Outcomes Research Team (PORT) comprised the national panel of experts. The researcher used the latest version of this software, released in June 1999. This instrument is in the public domain and can be downloaded from the www.hcfa.gov web site (Medquest, 2001).

Procedures. The Institutional Review Board (IRB) granted approval to complete the study (Appendix B). The researcher protected the patients' rights by not gathering personally identifiable data other than the medical record number. Once the medical record was reviewed, the researcher removed the medical record number from the database. Patient consent was not necessary due to the nature of ex post facto design and protection of subject identification and confidentiality.

The hospital database software was used to identify patients with DRG 89 and 90 as the primary diagnosis. DRG 89 was the reference for the diagnosis of simple pneumonia and pleurisy for patients who are greater than 18 years of age and who had complications. DRG 90 was the reference for a diagnosis of simple pneumonia and pleurisy for patients who were greater than 18 years of age and who did not have complications. Of the 730 patient medical records with DRG 89 and 90, only 349 were admitted to the hospital for one or more days. The 349 patients comprised the population from which the random sample was drawn.

Using a 5-digit table of random numbers, the researcher systematically randomized 250 medical records. The medical records were then submitted to the medical records department director to be obtained for initial review. The initial review was completed to separate subjects into two groups of 30. Group 1 was comprised of CAP patients that received IV antibiotics at or within 8 hours of arrival to the hospital. Group 2 comprised of CAP patients that received IV antibiotics after 8 hours of arrival to the hospital. For each record, the researcher recorded the time of arrival and the time of administration of IV antibiotics. The time that elapsed between these events was calculated and the patient was placed in one of two groups. Due to the small number of patients that received IV antibiotics after 8 hours of arrival, the investigator had to re-randomize medical records for subjects in group 2 multiple times.

Once the groups were randomly assigned, the researcher began data collection using the medical record audit tool adapted from MQIS: Pneumonia Module. Decisions regarding how to interpret various language found in the medical record were based on the clinical help guidelines found in the adapted version of the MQIS: Pneumonia Module software package (Appendix C). Decisions regarding the classification of IV antibiotic medications were based on a drug index provided by the hospital pharmacy (Appendix D). Guidelines for "appropriate" IV antibiotics were

established by the Infectious Disease Society of America's (IDSA) guidelines for treating the CAP population and were chosen standard for this research because they were the current standards referred in most recent literature.

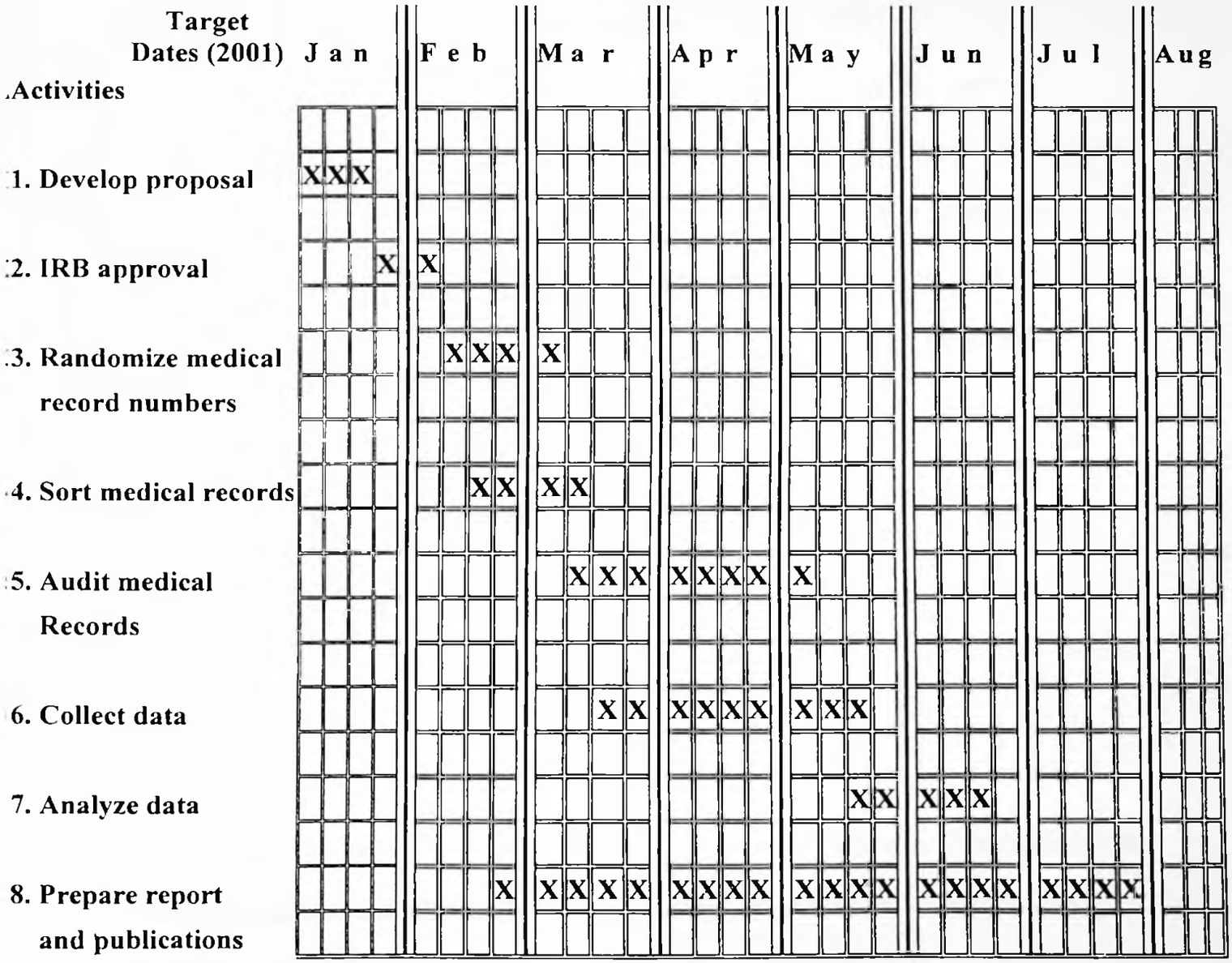
Limitations. The use of retrospective analysis is often subject to selection bias due to the convenience of drawing the sample from the first available subjects in the population. The researcher controlled for this bias by randomizing the sample from the hospitalized CAP population. In selecting this population by DRG association, the researcher may have excluded patients who were treated for pneumonia, but were not assigned to DRG 89 or 90 for unknown reasons. Another limitation of the study is the use of only one community hospital in the Appalachian region as well as the small sample size within this community hospital. Many other community hospitals exist in the region and may provide data that could support the hypothesis. The researcher acknowledges the complexities of a hospital system and how each department's (i.e. radiology, laboratory, respiratory therapy, and pharmacy) efficiency and effectiveness can have an impact on the timely administration of IV antibiotics to CAP patients. One such limitation might be the nurses ability to obtain the IV antibiotic after the order is received. If access is constrained by pharmacy flow problems, then it can be assumed that administration of the IV antibiotic will be delayed. Antibiotic resistance to particular drugs that may influence the client's responsiveness, and therefore the influence LOS, could create another limitation.

Another limitation of this study was the use of a weak definition of the community-acquired pneumonia. In this study, the researcher did not exclude patients who live in a long-term care facility. The investigator included this group in the sample because of the already limited number of subjects available for investigation. Excluding patients from long-term care facilities was recommended in the definition of CAP by Bartlett and colleagues in the Infectious Disease Society of America's

Guidelines for CAP in Adults (2000). This group of patients are constantly threatened by infection (similar to nosicomial infection found in the hospital setting), and may have therefore skewed the results of a more pure study of the CAP population.

Project Timeline.

This chart was used to establish deadlines and transition periods as the investigation progressed.



# Chapter 4

## Introduction

Chapter 4 describes the data analysis, the results, discussion, conclusions, and recommendations for future studies.

## Data Analysis

Frequency tables were used to describe (a) gender, (b) race, (c) age (d) type of IV antibiotic, (e) admission through the emergency department (ED), and (f) pneumonia diagnosis at admission characteristics of the sample. The sample was divided into two groups and randomly selected from the total population of patients with pneumonia diagnosis during fiscal year 2000. Group 1 ($n = 30$) consisted of patients diagnosed with community-acquired pneumonia (CAP) who received IV antibiotics at or within 8 hours of arrival to the hospital. Group 2 ($n = 30$) was comprised of patients diagnosed with CAP who received IV antibiotics after 8 hours of arrival to the hospital. Group means were examined for their differences in lengths of stay (LOS) to determine the affect of timely IV antibiotic administration for this CAP population. Data were analyzed using Statistical Processor for Social Sciences (SPSS) version 8.0 (SPSS for Windows, 1997).

## Results

Group One. The sample ($n = 30$) consisted of 15 females (50%) and 15 male (50%) who were primarily Caucasian and received IV antibiotics at or within 8 hours of arrival to the hospital. The majority of the individuals ($n = 14$, 46.7%) were between the ages 65 to 81 years of age. Sociodemographic characteristics are displayed in Table 1.

Patients were admitted through the emergency department ($n = 26$, 86.7%) or directly admitted to the nursing unit ($n = 4$, 13.3%) by the attending physician. All patients in the study

had a diagnosis of pneumonia per chest x-ray within 48 hours of arrival to the facility. Four (13.3%) patients were not admitted with pneumonia. Rather, these patients were diagnosed with pneumonia after admission, but within 48 hours of arrival to the hospital. Extended-spectrum cephalosporins were administered more often in the sample (n = 20, 66.7%) than other categories of IV antibiotic treatment. IV antibiotic, admission and diagnosis characteristics of the sample are displayed in Table 2.

The mean time to administration of IV antibiotics was 4.9 hours. For this group, IV antibiotics were administered as early as 1.25 hours after arrival to the hospital. The mean length of stay (LOS) was 7.0 days (SD = 4.09). The shortest LOS was 2 days and the longest LOS was 20 days.

Group Two. This sample (n = 30) consisted of 17 females (56.7%) and 13 male (43.3%) who were primarily caucasian and received IV antibiotics after 8 hours of arrival to the hospital. The majority of the individuals (n = 13, 43.3%) in this group were between 82 – 98 years of age. Sociodemographic characteristics are displayed in Table 1.

Patients were admitted through the emergency department (n = 26, 86.7%) or directly admitted to the nursing unit (n = 4, 13.3%) by the attending physician. All patients in the study had a diagnosis of pneumonia per chest x-ray within 48 hours of arrival to the facility. Eleven (36.7%) patients were not diagnosis with pneumonia until after admission to the nursing unit. Extended-spectrum cephalosporins were administered more often (n = 15, 50%) than other categories of IV antibiotic treatment. Fluoroquinolones were administered to 13 (43.3%) patients in the sample. Access, diagnosis, and type of IV antibiotic therapy are displayed in Table 2.

The mean time for administration of IV antibiotics for this group was 21.23 hours and IV antibiotics were administered as late as 76.75 hours after arrival to the hospital. The mean length of stay (LOS) was 8.5 days (SD = 5.88). The shortest LOS was 2 days while the longest LOS was 28 days.

Group Differences

Independent t tests were used to examine differences between LOS of patients who received IV antibiotics at or within 8 hours of arrival to the hospital and those who received IV antibiotics after 8 hours of arrival to the hospital. The t values revealed no significant difference in LOS between the two groups ($p = .25$). There was no significant difference between mean ages of the two groups ($p = .10$).

Hypothesis Testing

The alternative hypothesis, patients who were diagnosed with CAP who received IV antibiotic therapy within 8 hours had a shorter LOS than patients who are diagnosed with CAP and do not receive IV antibiotic therapy within 8 hours, was rejected. The results of the t test revealed no significant difference in LOS between the two groups. Conversely, the null hypothesis, there was no difference in LOS between patients who were diagnosed with CAP and received IV antibiotic therapy within 8 hours than patients who do not receive IV antibiotic therapy within 8 hours, was accepted. Independent t-tests for mean differences in LOS for the groups was non-significant ($p = .25$).

## Discussion

This sample ($N = 60$) had longer LOS ($M = 7.72$, $SD = 5.08$) than the national average LOS of CAP patients reported by Health Care and Utilization Project (2000) in 1997 ($M = 4.9$). The study sample also had a longer LOS than the group studied by Schwartz and colleagues

(M = 5.1, SD = 3.0) in 1998. Feagan and colleagues (2000) assert that even when considering Pneumonia Severity Index (PSI) scores, COPD diagnosis, and diagnosing pneumonia by laboratory results it is difficult to predict LOS for this population. This sample had a similar time to initial IV antibiotic administration (M = 13.07, SD = 12.95) as the findings of Schwartz and colleagues (M = 12.8, SD = 9.9).

In this sample (N = 60), extended-spectrum cephalosporins were administered most often (58.3%). This was the same as Halm and colleagues' findings where extended-spectrum cephalosporins (40%) were administered frequently. In the same study by Halm and colleagues macrolides were also administered more often (43%), while in this investigation these antibiotics were rarely used (n = 2, 3.3%). In Schwartz and colleagues' and Feagan and colleagues' studies, β-lactam therapy was most frequently administered IV antibiotic therapy (40% and 32% respectively). All three antibiotic therapies were considered appropriate treatments based on the Infection Disease Society of America's standards for treating adult patients with Community-Acquired Pneumonia.

Confounding Variables

LOS was found not to be significantly different between the two study groups. This could be because LOS can be influenced by many factors other than the patient's clinical stability related to the CAP diagnosis.

Comorbid disease as defined by Tabor's Cyclopedic Medical Dictionary (1993) is "a disease coexisting with the primary disease." Fein, A., Grossman, R., Ost, D., Farber, B., & Cassiere, H. assert that pneumonia is often found in patients with comorbidities and that comorbidities may delay the resolution of pneumonia (1999). The investigator suspects that comorbid disease could have been a factor influencing LOS for this sample. For example, a

patient admitted with CAP as the primary diagnosis, also had a secondary diagnosis of diabetes mellitus and would not be likely to recover from CAP as quickly as one who had no secondary diagnosis or comorbidity. The Appalachian population is well known for its poor health status as evidenced by high rates of chronic diseases (such as cardiac [WVBPH, 2000], chronic obstructive pulmonary [COPD; WV Hospital Administration, 2001], and diabetes mellitus). Francis Cordova (2000) states the presence of comorbid diseases such as COPD, diabetes mellitus, congestive heart failure, and renal insufficiency, significantly increase one's risk for CAP. Therefore, future studies of CAP that involve comorbid conditions should be considered as an important confounding variable for examination.

The hospital system has many extraneous factors influencing LOS. Extraneous factors may have influenced IV antibiotic therapy for LOS in this CAP population. Physicians' practice may be another factor influencing LOS in this sample.

As the volume of CAP patients continue to rise, it becomes increasingly important to find ways to collaborate with the physicians in order to implement treatment regimens that reduce LOS among the CAP population. Finding effective treatments for CAP patients will allow redistribution of human and financial resources for this ambulatory care population.

## Conclusion

Based up on the results of this study, the timely administration of IV antibiotic therapy to the CAP sample did not reduce LOS. The nursing staff at this hospital understands the importance of timely treatment intervention. This was evidenced by 77% of the study population receiving IV antibiotics within 8 hours of arrival to ED or nursing unit. With only a small portion (23%) of patients receiving IV antibiotic therapy after 8 hours of arrival, finding patients who met inclusion criteria for Group 2 was arduous. The purpose of this study was to examine

one area of human and financial resource reduction where a particular population consumed large amounts of resources. Examining and streamlining human resource use is important for the enhancement of quality of care.

## Recommendations for Future Research

To determine the influence of timely IV antibiotic administration on LOS for a CAP population, the author recommends measuring the time to clinical stability (i.e. vital signs, ability to eat, and mental status), as opposed to LOS. Investigating the influence on LOS in the CAP population must include a component that considers comorbid conditions. Studying groups with comorbid conditions would be most beneficial because these groups probably consume the most resources for the CAP diagnosis.

The Pneumonia Severity of Illness index (Fine, M. F., Hanusa, B. H., Lave, J., Singer, D.e., Stone, R. a., Weissfeld, L. A., Coley, C. M., Marrie, T. J., & Kapoor, W. N., 1995) would be useful in determining both the patients' long-term-care status and provide a measure of comorbid influences. Further investigation of the relationship between existing comorbidities and the time to clinical stability and discharge would be useful in evaluation of LOS in the CAP population. The Medicare Quality Indicator System: Pneumonia Module (1999) provided a wide variety of data collection functions that were removed for this study. The use of the complete tool would provide more useful information for analyzing comorbidity and other data that might influence LOS in the CAP population. Continued research on the use of oral antibiotic therapy, as opposed to IV antibiotic therapy, is another important factor in reducing LOS and ultimately cost of care. Further investigation should be conducted to support Chan & Hemeryck's conclusions that the use of oral antibiotic therapy in the CAP population are at least as efficacious as IV therapy (1995).

In summary, the results of this study support evidence that in this sample of CAP patients in the Appalachian region of the United States, the administration of appropriate IV antibiotic therapy within 8 hours of arrival to the hospital does not significantly influence the LOS. Further investigation is needed to better understand the factors influencing this finding.

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Table 1

Sociodemographic Characteristics of the Study Sample (N = 60).

| Characteristic | Group 1 IV antibiotics ≤ 8 hours (n = 30) | | Group 2 IV antibiotics > 8 hours (n = 30) | |
|---|---|---|---|---|
| | n | % | n | % |
| Age range | | | | |
| 31-47 | 4 | 13.3 | 2 | 6.7 |
| 48-64 | 4 | 13.3 | 3 | 10.0 |
| 65-81 | 14 | 46.7 | 12 | 40.0 |
| 82-98 | 8 | 26.7 | 13 | 43.3 |
| Race | | | | |
| Caucasian | 29 | 96.7 | 29 | 96.7 |
| Non-Caucasian | 1 | 3.3 | 1 | 3.3 |
| Gender | | | | |
| Female | 15 | 50.0 | 17 | 56.7 |
| Male | 15 | 50.0 | 13 | 43.3 |

Table 2

Sample Characteristics for IV Antibiotic, Admission, and Diagnosis (N = 60).

| Characteristic | Group 1 IV antibiotics ≤ 8 hours (n = 30) | | Group 2 IV antibiotics > 8 hours (n = 30) | |
|---|---|---|---|---|
| | n | % | n | % |
| IV Antibiotic Type | | | | |
| Beta-lactam/Beta lactamase inhibitor | 1 | 3.3 | 1 | 3.3 |
| Extended spectrum cephalosporin | 20 | 66.7 | 15 | 50.0 |
| Fluoroquinolone | 8 | 26.7 | 13 | 43.3 |
| Macrolides | 1 | 3.3 | 1 | 3.3 |
| Admitted from E.D. | | | | |
| Yes | 26 | 86.7 | 26 | 86.7 |
| No | 4 | 13.3 | 4 | 13.3 |
| Pneumonia Dx upon admission to nursing unit | | | | |
| Yes | 26 | 86.7 | 19 | 63.3 |
| No | 4 | 13.3 | 11 | 36.7 |

Appendix A

1LENGTH OF STAY FOR C.A.P. PATIENTS WITH IV ANTIBIOTICS – MEDICAL RECORD AUDIT TOOL

**Prevalidation:**

Transfer from acute care hospital?

Pneumonia working diagnosis at admission?

Aspiration pneumonia considered?

Bronchiectasis considered?

Chest x-ray 48 hours before or after admission that shows pneumonia?

Older than 18 years of age?

Comfort measures only?

Has the patient:

Been discharged from a hospital in the past 14 days?

Had chemotherapy within 60 days?

Had a history of: organ transplant, TB, HIV, or AIDS?

Was the patient discharged on the day of admission?

Did the patient leave AMA?

**Demographics:**

Admission date:

Discharge date:

Arrival date:

Arrival time:

Age:

Gender:

Race:

Admitted through E.D.?

Direct admit?

**Medications:**

Type of anitbiotic(s): [extended spectrum cephalosporin] [macrolide] [β-lactam/β-lactamase inhibitor] [fluoroquinolone]

Antibiotics initiated – date:

Antibiotics initiated – time:

[1] This tool is an adaptation of the Medicare Quality Indicator System: Pneumonia Module (1999)

Appendix B


February 2, 2001

Shane Hammock, RN
466 17th Street
Dunbar, WV 25064

Dear Mr. Hammock,

The Thomas Hospital Ethics Advisory and IRB Committee reviewed your proposed research, "Examination of IV Antibiotic Use and Length of Stay in Community-acquired Pneumonia." An expedited review was granted related to the low risk to patient safety because patient consent is not needed for this retrospective chart review.

Approval is contingent on the protection of patient privacy for identifiable health information. Records may not be reviewed outside of the Medical Records Department and only medical record numbers will be used. These numbers will be removed from the data base once the data is compiled.

Please submit a summary of your findings at the conclusion of your study to complete your IRB file. Best wishes with your project and in your continued studies.

Sincerely,

Dr. Bruce Foster,
Ethics/IRB Chair

**Thomas Memorial Hospital**
4605 MacCorkle Avenue, SW ■ South Charleston, WV 25309 ■ 304-766-3600

Appendix C

IVAB CAP module
Clinical help guidelines for data collection for Examination of IV Antibiotic Use and Length of Stay in Community-Acquired Pneumonia Patients

Originally Medicare Quality Indicator System: pneumonia module (1999) - Version: P0106
Original Date: 6/7/99

Adapted for CAP study Spring/2001

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**Prevalidation Screen**

**Sources:**
**Preferred Sources:**
Check individual variables.

**Transfer from acute care hosp**

**Question:**
Was the patient being admitted to this hospital as a transfer after being an in-patient at a different acute care hospital?

**Sources:**
**Preferred Sources:**
Transfer forms, H&P, nursing admission note, progress notes

**Instructions:**
Patients seen as out-patients in the emergency room of another hospital (but not admitted to that hospital) and transferred to this hospital for in-patient admission are not considered to be transferred from in-patient acute care.

- If the patient was transferred from the observation unit or bed of another hospital, answer Yes.

Exclude from acute care hospitals:

- Psychiatric hospitals
- Nursing homes
- Rehabilitation hospitals
- Inpatient hospice units
- Long-term care facilities
- Any medical facilities that are not acute care

**Options:**

a. Mark 'Y' if this admission occurs as the result of an acute care transfer.

b. Mark 'N' if this admission is not an acute care transfer.

c. Mark 'U' if there is insufficient documentation or the documentation is illegible.

- This subject should be excluded if the record documents a transfer from an acute care facility.

**Pne working diagnosis at adm**

**Question:**

Was pneumonia among the working diagnoses on admission? Documentation of pneumonia must be written before or at admission, and may not be taken from notes written at any later point in time.

**Sources:**
**Only Acceptable Sources:**
Physicians documentation only - emergency room doctors' notes, H&P, physician admission note, admission orders

**Instructions:**
This information cannot be taken from discharge summary, coding or billing documents. Only sources as listed above may be used.

A consultation note that is done while the patient is still in the emergency room is considered to be an emergency room doctor's note. If the consultation note is written after the patient has been transferred from the emergency room, this may not be used as a source. If unable to determine if the note is written in the emergency room or after admission, do not use as source. Only use consult notes if they are documented as done in the emergency department.

Do not take information from consultation notes or doctor's progress notes written later than admission, even if dated the day of, or day after, admission.

**Instructions:**
**Options:**
a. Mark 'Y' if:

- The emergency department or admitting physician thought that the patient had or might have had pneumonia at the time of admission. Pneumonia need not be the primary or only diagnosis, but must be mentioned as a working diagnosis at the time of admission.
- Documentation shows that pneumonia was considered as a working diagnosis.

**Inclusions:**

- Infection of a specific lobe or lobes of lung (i.e. right lower lobe infection).
- Pneumonia of any type
- Pneumonitis
- Pneumonia qualified as 'rule/out, questionable, possible, probable, or need to evaluate for, or any qualifier other than doubt. The phrase "doubt pneumonia" is not considered a working diagnosis.
- A working diagnosis of pneumonia that documented in the ER, H&P, admission orders, or doctors admission note.
- Include Infiltrate only when documented as an admission impression or diagnosis; do not include if only mention of infiltrate is in body of ER note or body of history and physical without inclusion in final impression listing working diagnosis at admission.

**Exclusions:**

- Aspiration without mention of pneumonia.
- Respiratory problems without mention of pneumonia or pneumonitis.
- Pneumonia that is diagnosed during the stay but is not an admission working diagnosis.
- Do not include the billed claims data or only accept the admitting diagnosis for the initial working diagnosis.

- Pneumonia discussed in one of four sources by physician when described as "doubt pneumonia is present", or phrase indicating physician does not think pneumonia is present.
- If the only documentation of pneumonia is an admitting order for "CXR to R/O pneumonia", this is not sufficient documentation to be considered a working diagnosis.

b. Mark 'N' if:

- Documentation shows that pneumonia was not an admission diagnosis.
- There is no mention of pneumonia as a consideration for cause of admission.
- Documentation shows physician doubts pneumonia is present.

c. Mark 'U' if there is insufficient documentation or the documentation is illegible. Must consult clinical supervisor before selecting "UTD."

## Aspiration pneumonia consider

**Question:**
Was aspiration pneumonia considered?
**Sources:**
**Only Acceptable Sources:**
Physicians documentation only - emergency room doctors' notes, H&P, physician admission note, admission orders

**Instructions:**
This information cannot be taken from discharge summary, coding or billing documents. Only sources as listed above may be used.

A consultation note that is done while the patient is still in the emergency room is considered to be an emergency room doctor's note. If the consultation note is written after the patient has been transferred from the emergency room, this may not be used as a source. If unable to determine if the note is written in the emergency room or after admission, do not use as source. Only use consult notes if they are documented as done in the emergency department.

Do not take information from consultation notes or doctor's progress notes written later than admission, even if dated the day of, or day after, admission.

**Options:**

a. Mark 'Y' if:

- The emergency department or admitting physician thought that the patient had or might have had aspiration pneumonia at the time of admission. Aspiration pneumonia need not be the primary or only diagnosis, but must be mentioned as a working diagnosis at the time of admission.
- Documentation shows that aspiration pneumonia was considered as a working diagnosis.

**Inclusions:**

- Aspiration pneumonia qualified as 'rule/out, questionable, possible, probable, or need to evaluate for, or any qualifier other than doubt.
- A working diagnosis of aspiration pneumonia that was documented in the ER, H&P, admission orders, or doctors admission note.

**Exclusions:**

- Aspiration without mention of pneumonia.
- Respiratory problems without mention of aspiration pneumonia.
- Aspiration pneumonia that is diagnosed during the stay but is not an admission working diagnosis.
- Do not include the billed claims data or only accept the admitting diagnosis for the initial working diagnosis.
- Aspiration pneumonia discussed in one of four sources by physician when described as "doubt aspiration pneumonia is present", or phrase indicating physician does not think aspiration pneumonia is present.

b. Mark 'N' if:

- Documentation shows that aspiration pneumonia was not an admission diagnosis.
- There is no mention of aspiration pneumonia as a consideration for cause of admission.
- Documentation shows physician doubts aspiration pneumonia is present.

c. Mark 'U' if there is insufficient documentation or the documentation is illegible. Must consult clinical supervisor before selecting "UTD."

**Bronchiectasis considered**

**Question:**
Was bronchiectasis considered?
**Sources:**
**Only Acceptable Sources:**
Physicians documentation only - emergency room doctors' notes, H&P, physician admission note, admission orders

**Instructions:**
This information cannot be taken from discharge summary, coding or billing documents. Only sources as listed above may be used.
The intent of this question is to determine if bronchiectasis was a working diagnosis at the time of admission.
A consultation note that is done while the patient is still in the emergency room is considered to be an emergency room doctor's note. If the consultation note is written after the patient has been transferred from the emergency room. this may not be used as a source. If unable to determine if the note is written in the emergency room or after admission, do not use as source. Only use consult notes if they are documented as done in the emergency department.

Do not take information from consultation notes or doctor's progress notes written later than admission, even if dated the day of, or day after, admission.

**Options:**

a. Mark 'Y' if:

- The emergency department or admitting physician thought that the patient had or might have had bronchiectasis at the time of admission. Bronchiectasis need not be the primary or only diagnosis, but must be mentioned as a working diagnosis at the time of admission.
- Documentation shows that bronchiectasis was considered as a working diagnosis.

**Inclusions:**

- Bronchiectasis qualified as 'rule/out, questionable, possible, probable, or need to evaluate for, or any qualifier other than doubt.
- A working diagnosis of bronchiectasis that documented in the ER, H&P, admission orders, or doctors admission note.
- Include bronchiectasis only when documented as an admission impression or diagnosis; do not include if only mention of bronchiectasis is in body of ER note or body of history and physical without inclusion in final impression listing working diagnosis at admission.

**Exclusions:**

- Respiratory problems without mention of bronchiectasis.
- Bronchiectasis that is diagnosed during the stay but is not an admission working diagnosis.
- Do not include the billed claims data or only accept the admitting diagnosis for the initial working diagnosis.
- Bronchiectasis discussed in one of four sources by physician when described as "doubt bronchiectasis is present", or phrase indicating physician does not think bronchiectasis is present.

b. Mark 'N' if:

- Documentation shows that bronchiectasis was not an admission diagnosis.
- There is no mention of bronchiectasis as a consideration for cause of admission.
- Documentation shows physician doubts bronchiectasis is present.

c. Mark 'U' if there is insufficient documentation or the documentation is illegible. Must consult clinical supervisor before selecting "UTD."

**Any x-ray showed pneumonia**

**Question:**
Any x-ray within two calendar days prior to arrival or up to two calendar days after arrival showed pneumonia?
**Sources:**
Preferred Source:
Radiology report (Chest x-ray report)
**Additional Sources: Physician H&P/progress notes, physician emergency room notes,**
Physician notes (exclude medical student and physician assistant notes), MD consult notes.

**Instructions:**
Do include information from H&P, ER MD note, progress notes and consult notes as well as from radiology report.

If there is conflicting information (i.e., the radiologist says no infiltrate but the physician states in his progress notes CXR shows pneumonia) take the worst finding.

Findings from regular and portable chest x-rays
should be abstracted. If there is conflicting information, take any positive findings consistent with pneumonia from any x-ray report or from any physician note.

This should be abstracted if pneumonia is documented as being present on any chest x-ray done between two calendar days prior to arrival or up to two calendar days after arrival.

**Options:**

a. Mark 'Y' if pneumonia is present on an x-ray (within two calendar days prior to arrival or up to two calendar days after arrival), from either radiology report or doctor's notes discussing x-ray results.

**Synonyms/Inclusions:**

- Air bronchogram
- Air space disease
- Consolidation
- Infiltrate
- Inflammation
- Opacity
- Pneumonia
- Pneumonitis

**Exclusions:**

- ARDS (Adult Respiratory Distress Syndrome)
- Chronic findings would include: chronic pneumonitis, old infiltrate, pleural plaque, scarring, fibrosis, and cysts.
- Density noted on chest x-ray is not a synonym for pneumonia.
- Pneumonia as a chronic finding without any acute or new finding of pneumonia.
- Reports with the sole presence of pleural effusion, CHF, atelectasis, fibrosis or nipple shadow are not sufficient for a diagnosis of pneumonia.

b. Mark 'No' if pneumonia is not documented in any discussion of x-ray results (within two calendar days prior to arrival or up to two calendar days after arrival).

c. Mark 'UTD' if there is insufficient documentation or the documentation is illegible.

- This subject should be excluded if the record does not document a finding consistent with pneumonia.

## Older than 18 years of age

See "Age" section in Demographics.

## Comfort measures only

**Question:**

Is there physician documentation that the plan of care is aimed toward comfort measures only?

**Sources:**

Physician Documentation Only: Emergency room MD record, History and physical (H&P), Physician consultation notes, Physician progress notes.

**Instructions:**

- Intent of question is to identify patients who might not have received usual interventions because a medical

decision was made to limit care to comfort measures only.

- Information should be taken from physician documentation only, from anytime during the stay.

**Options:**

a. Mark "Yes" if there is any physician documentation that the plan of care for treatment of this patient is aimed at comfort measures only.

**Synonyms/Inclusions:**

- Comfort measures only
- Hospice care
- MD documentation that care is being limited at request of patient and/or family due to patient's age, chronic or terminal illness, or other quality of life issue.
- No aggressive interventions
- Palliative care
- Supportive care only

Exclude:

- DNR
- Living Will.
- No Code
- No heroic measures

b. Mark "No" if there is no physician documentation that the plan of care for treatment of this patient is aimed at comfort measures only

c. Mark "UTD" for unable to determine if documentation is insufficient or illegible.

- This subject should be excluded if the record documents comfort measures only.

**Readmitted within 14 days**

**Question:**

Was the patient readmitted to this hospital after having been discharged from an acute care facility to a non-acute setting within the last 14 days?

**Sources:**

**Preferred Sources:**

Emergency department record, H&P, nurses' admission notes, consultants' notes, admission face sheet, discharge summary

**Instructions:**

When a patient is readmitted, it means the patient was discharged from an acute care facility to a non-acute setting (i.e., home, SNF, ICF, or rehabilitation hospital), before this second admission to the same or different acute care facility.

When counting to determine the number of days after discharge, the day after the date of actual discharge is counted as day one.

If documentation shows the patient was discharged "one week ago", subtract 7 days from the arrival date and enter this date as discharge date from previous admission.

If documentation of exact date is vague but can be determined it was within 14 days, answer "Yes" to this question and enter an "X" for the date question that follows. For example, documentation states patient was discharged "a couple of days ago" or "last week". Enter yes to this question, and " X" for the date.

**Options:**

a. Mark 'Y' if patient was readmitted within 14 days.

b. Mark 'N' if patient was not readmitted within 14 days.

c. Mark 'U' if

- The documentation only notes 'recent' admission.
- There is insufficient documentation or the documentation is illegible.

- This subject should be excluded if the record documents admission to an acute care facility within 14 days prior to this admission.

**Chemotherapy within 60 days**

**Question:**
Chemotherapy within 60 days of arrival?
**Sources:**
**Preferred Sources:**
Physician H&P/admission notes, physician/nurses' emergency room notes, arrest record, physician progress notes, consultant notes, nurses' admission/assessment notes

**Note:**
Physician notes exclude medical student and physician assistant notes.

**Instructions:**
**Definition:**
This subject should be excluded if the record documents a history of chemotherapy within 60 days of arrival.

**Organ transplant, Tuberculosis, HIV, of AIDS**

**Question:**
History of organ transplant, TB, HIV, or AIDS?
**Sources:**

**Preferred Sources:**
Physician H&P/admission notes, physician/nurses' emergency room notes, arrest record, physician progress notes, consultant notes, nurses' admission/assessment notes

**Note:**
Physician notes exclude medical student and physician assistant notes.

**Instructions:**
**Definition:**
This subject should be excluded if the record documents a history of organ transplant, TB, HIV, or AIDS.

**Transplant inclusions:**
- Heart
- Liver
- Kidney
- Lung
- Bone marrow

**Transplant exclusion:**
Corneal lens transplant for cataract treatment.

**Demographics**

**Adm. date**

**Question:**
What was the date the patient was admitted to the hospital?

**Sources:**
**Preferred Sources:**
ER record, History and Physical (H&P), Nursing assessment, Surgery or procedure notes.

**Instructions:**
**Guidelines:**
- Enter the date the patient was admitted to the hospital as an inpatient. If the patient arrives through the ER and is held in observation for a day or two, use the date of arrival to the for the admission date.

**D/C date**

**Question:**
What was the date the patient was discharged from the hospital, left against medical advice, or expired?
**Sources:**
**Preferred Sources:**

Discharge summary, Transfer note, Nursing discharge note, Progress notes, Test reports, Graphic sheet.

**Instructions:**
**Guidelines:**

- If either the admission date or the discharge date found in the chart do not agree with the UB-92 information, give the chart to your supervisor or troubleshooter for further investigation.

## Arrival date

**Question:**
What was the date the patient arrived at the hospital?

**Sources:**
**Preferred Sources:**
Emergency room notes, History and physical (H&P), Progress notes, Nursing admission assessment.

**Guidelines:**

- Do not use the face sheet or ambulance record for this information. The intent of this variable is to capture the earliest time the patient was in the hospital.
- If the patient is admitted for 23 hour observation and later admitted to the unit or floor, abstract the date the patient arrived at the hospital for the 23 hour observation.
- Do not take dates from address-o-graphs/stamps.
- Arrival dates can be taken from signed consent forms and half and half ER forms (half Registration/half Clinical information or Consent form).
- If the patient is admitted to the hospital to a non-acute care unit (i.e. psychiatric or rehab), and is then transferred to acute care, the arrival date would be the date the patient is transferred to the acute care phase.

## Arrival time

**Question:**
What was the time the patient arrived at the hospital?

**Sources:**
**Preferred Sources:**
Emergency room notes, History and physical (H&P), Progress notes, Nursing admission assessment.

**Instructions:**
**NOTE:**
This may differ from the times found in the Admission/Registration office, which may be recording the time the patient was processed for admission. Remember the intent of this variable is to capture the earliest time the patient was in the ER/hospital.

**Guidelines:**

- Do not use the face sheet or ambulance record for this information. The intent of this variable is to capture the

earliest time the patient was in the hospital.

- Do not take times from address-o-graphs/stamps.
- Arrival times can be taken from signed consent forms and half and half ER forms (half Registration/half Clinical information or Consent form).
- If the patient is admitted to the hospital to a non-acute care unit (i.e. psychiatric or rehab), and is then transferred to acute care, determine the arrival time by applying the billing information to the criteria below.
  - If the medical record contains dates from the time the patient entered the acute care phase (CCU stay) then the admission date and the arrival time would be the CCU stay.
  - If the medical record has the non-acute stay and the acute stay together, abstract the arrival date and time as the time the patient was transferred to the acute care phase of the stay. If the time cannot be determined, enter Shift ? (X).

## Age

**Question:**
What was the patient's age?

**Sources:**
**Preferred Sources:**
Face sheet.
**Additional Sources:**
Admission record, ER record, Registration form.

**Instructions:**
**Guidelines:**

- Use documentation from the Face sheet first. If there is no documentation or conflicting documentation on the Face sheet, look at the additional sources. If there is no documentation or conflicting documentation on the additional sources, enter Shift ? (X).
- If there is no date of birth documented in the record, enter Shift ? (X).

## Gender

**Question:**
What was the patient's gender?

**Sources:**
**Priority Sources:**
Face sheet.
**Additional Sources:**
Registration form, Admission record, ER record, Nursing assessment.

**Instructions:**
**Guidelines:**

- Do not use a number system for abstracting gender unless a key is included in the record (i.e. 1=Male, 2=Female, etc).
- Use documentation from the Face sheet first. If there is no documentation or conflicting documentation on the Face sheet, look at the additional sources. If there is no documentation or conflicting documentation on the additional sources, enter Shift ? (X).

**Options:**

a. Mark "Male" if the patient was male.

b. Mark "Female" if the patient was female.

c. Mark "UTD" if there is insufficient information or if documentation is illegible.

## Race

**Question:**
What was the patient's race?

**Sources:**
**Priority Sources:**
Face sheet.
**Additional Sources:**
Emergency room record, History and physical (H&P), Nursing admission assessment, Physician assessment.

**Instructions:**
Enter the patient's race as defined below.

**Guidelines:**

- Use documentation from the Face sheet first. If there is no documentation or conflicting documentation on the Face sheet, look at the additional sources. If there is no documentation or conflicting documentation on the additional sources, enter Shift ? (X).
- Do not use a number system to abstract the race unless a number key is provided.

**Options:**

a. Mark "Caucasian/White" if the patient's race was Caucasian/White or having origins in Europe, the Middle East or North Africa.

**Synonyms/Inclusions:**

- Caucasian
- Iranian
- Middle Easterner
- W
- Whi
- White

b. Mark "African American/Black/Negro" if the patient's race was African American/Black/Negro.

**Synonyms/Inclusions:**

- African-American

- B
- Black
- Haitian
- Negro

c. Mark "American Indian/Alaska Native" if the patient's race was American Indian/Alaska Native.

**Synonyms/Inclusions:**
- Alaska Native
- American Indian
- Any recognized tribal entity in North and South America (including Central America)
- Native American

d. Mark "Asian" if the patient's race was Asian/Far East/Indian.

**Synonyms/Inclusions:**
- Asian
- Asian-American
- Cambodian
- Chinese
- Far East
- Filipino
- Japanese
- Korean
- Malaysian
- Pakistani
- South East Asian
- Thailand
- Vietnamese

e. Mark "Native Hawaiian/Pacific Islander" if the patient's race was Native Hawaiian/Pacific Islander.

**Synonyms/Inclusions:**
- Guam
- Hawaiian
- Other Pacific Islands
- Samoan

f. Mark "Other" if the race does not fit into one of the categories.

Synonyms/Inclusions:
- Mixed Race

g. Mark "UTD" if there is insufficient information or if documentation is illegible.

**Admitted thru emergency dept**

**Question:**
Was the patient admitted to the hospital after initial treatment in this hospital's emergency room?

**Sources:**
**Preferred Sources:**
Any emergency room records, triage nursing notes, H&P, nursing admission notes, progress notes

**Instructions:**
**Options:**
a. Mark 'Y' if:
- The patient was evaluated or treated in the ER prior to admission to an observation or inpatient unit.
- This admission occurred after initial treatment in the emergency room of this hospital.

**Inclusions:**
May include emergency room, emergency department, ER, or ED.

**Exclusions:**
Admissions from any other location other than this hospital's emergency room, including transfers from other hospital's emergency rooms, acute care hospital transfers, and outpatient settings.

Patients who only had administrative papers completed in ER, but were neither evaluated nor treated in the ER, are not considered ER admissions.

b. Mark 'N' if this admission was not through the emergency department.

c. Mark 'U' if there is insufficient documentation or the documentation is illegible.

d. If 'N' then 'Y' admitted as a direct admit.

**Medications**

**Type of IV Antibiotics initiated**

**Question:**
Name of initial IV antibiotic medication given during this hospitalization.

**Sources:**
**Preferred Sources:**
Any part of the emergency/observation room records (including emergency room progress notes), medication administration records (including the one time and stat dose section of the MAR), IV flow sheets, ICU flow sheets, any source documenting IV antibiotic administration

**Instructions:**

- IV antibiotics are to be classified as one of the following:
  macrolides
  extended-spectrum cephalosporins
  β-lactam/β-lactamase inhibitors
  fluoroquinolones

- Refer to the drug index when assigning generic or trade names of medications to drug classes.
- If the IV antibiotic is not classified under one of the four above classes, mark "Other."

Do not abstract antibiotics given these routes:

- Orally (PO)
- Feeding tubes (NG, PEG)
- IM
- Inhalation
- Eardrops
- Mouthwash (swish and spit)
- Neomycin given rectally
- Ophthalmic eyedrops
- Peritoneal dialysate (antibiotics added to)
- Swish and spit
- Swish and swallow (S/S)
- Topical antibiotics (neosporin ointment)
- Vaginal administration
- Wound irrigations

Press 'Shift-?' if name of the antibiotic documented is illegible or there is insufficient documentation.

**Antibiotics initiated - date**

**Question:**
Date antibiotics initiated
**Sources:**
**Preferred Sources:**
Any part of the emergency/observation room records (including emergency room progress notes), medication administration records (including the one time and stat dose section of the MAR), IV flow sheets, ICU flow sheets, any documentation of antibiotic administration during stay

**Instructions:**
Enter the start date of each antibiotic administered. If a medication sheet does not document a date, but you can determine the date based on nursing notes or other documentation, then abstract the date. If the start date is illegible abstract "X", do not go to the next legible date.

Only those dates that are 'signed off' or initiated as given, should be abstracted.

Press 'Shift-X' if:

- The start date cannot be determined.
- There is insufficient documentation or the documentation is illegible.
- If the start date is illegible, do not look for the next legible date, enter "Shift-X".

**Antibiotics initiated - time**

**Question:**
Time antibiotics initiated
**Sources:**
Any part of the emergency/observation room records (including emergency room progress notes), medication administration records (including the one time and stat dose section of the MAR), IV flow sheets, ICU flow sheets, any documentation of antibiotic administration during stay

**Instructions:**
Enter the start time of each antibiotic administered. If a medication sheet does not document a time, but you can determine the time based on nursing notes or other documentation, then abstract the time. If the start time is illegible abstract "X", do not go to the next legible time.

**Notes:**
Only those times that are 'signed off' or initiated as given, should be abstracted. Follow general abstraction guidelines if first dose is given at 24:00.

**Example:**
If first dose is administered on 06/01/96 at 24:00, enter information into MQIS as 06/02/96 at 00:00.

Enter 'X' if:

- The start time cannot be determined.
- There is insufficient documentation or the documentation is illegible.
- If the start time is illegible, do not look for the next legible time, enter "Shift-X".

Appendix D

# Main Index (1 of 4)


▶Analgesics
Acetaminophen (Aspirin Free Anacin®, Feverall®, Panadol®, Tylenol®)
Acetaminophen; Butalbital; Caffeine (Anolor 300®, Endolor®, Esgic®, Esgic-Plus®, Fioricet®, Zebutal™)
Acetaminophen; Dichloralphenazone; Isometheptene (Amidrine®, Duradrin™, Midchlor®, Midrin®, Migquin™, Migratine™, Migrazone™, Migrex™, Mitride™)
Acetaminophen; Pseudoephedrine (Actifed® Sinus Daytime, Alka-Seltzer Plus® Cold & Sinus Medicine Liqui-Gels®, Allerest® No-Drowsiness, Aspirin-Free Bayer® Select Sinus Pain Relief, Bayer® Select Head Cold, Children's Tylenol® Sinus, Coldrine®, Contac® Allergy/Sinus Day, Contac® Maximum Strength Sinus, Contac® Non-Drowsy Formula Sinus, Dristan® Cold, Dynafed® Maximum Strength, Infants' Tylenol® Cold Decongestant & Fever Reducer, Maximum Strength Tylenol® Sinus, Naldegesic®, Ornex® Maximum Strength, Ornex® No Drowsiness, PhenAPAP® Without Drowsiness, Sinarest® No-Drowsiness Maximum Strength, Sine-Aid® Maximum Strength, Sine-Off® Maximum Strength No Drowsiness Formula, Sinus Excedrin® Extra Strength, Sinus-Relief®, Sinutab® Sinus Maximum Strength Without Drowsiness, Sinutrol® 500, Sudafed® Cold & Sinus, Sudafed® Sinus Maximum Strength Without Drowsiness, TheraFlu® Sinus Maximum Strength, Tylenol® Sinus Maximum Strength, Vicks DayQuil® Sinus Pressure & Pain Relief)
Phenazopyridine (Pyridiate®, Pyridium®, Urodol®, Urogesic®, Viridium®)
Tramadol (Ultram®)
▶Mixed Opiate Agonists/Antagonists
Butorphanol (Stadol®)
Nalbuphine (Nubain®)
Pentazocine (Talwin®, Talwin® Nx)
▶Nonsteroidal Antiinflammatory Drugs (NSAIDs)
Bromfenac (Duract™)
Diclofenac (Cataflam®, Pennsaid®, Solaraze™, Voltaren®)
Diclofenac; Misoprostol (Arthrotec®)
Etodolac (Lodine®, Lodine® XL)
Fenoprofen (Nalfon®)
Flurbiprofen (Ansaid®, Ocufen®)
Hydrocodone; Ibuprofen (Vicoprofen®)
Ibuprofen (Advil®, Advil® Migraine, Excedrin® IB, Motrin®, Motrin® Migraine Pain, Nuprin®, Pedia Care® Fever Drops, Provel®, Rufen®)
Indomethacin (Indocin®)
Ketoprofen (Actron™, Orudis®, Oruvail®)
Ketorolac (Acular®, Toradol®)
Meclofenamate, Mefenamic Acid (Meclomen®, Ponstel®)
Meloxicam (Mobic®)
Nabumetone (Relafen®)
Naproxen (Anaprox®, Aleve®, Naprelan®, Napron X®, Naprosyn®)
Oxaprozin (Daypro®)
Piroxicam (Feldene®)
Sulindac (Clinoril®)
Tolmetin (Tolectin®)
▶*COX-2 inhibitors*
Celecoxib (Celebrex™)
Rofecoxib (Vioxx®)
▶Opiate Agonists
Acetaminophen; Butalbital; Caffeine; Codeine (Fioricet® w/Codeine)
Acetaminophen; Codeine (Aceta™ with Codeine, Capital® with Codeine, Phenaphen® with Codeine, Pyregesic-C™, Tylenol® No. 2, Tylenol® No. 3, Tylenol® No. 4, Tylenol® with Codeine)
Acetaminophen; Hydrocodone (Anexsia®, Bancap™ HC, Ceta-Plus™, Co-Gesic®, Dolacet™, Dolagesic™, Dolorex™ Forte, Duocet™, Hy-Phen®, Hydrocet™, Hydrogesic™, Lorcet®, Lorcet-HD, Lorcet® Plus, Lortab®, Margesic-H™, Norco®, Panacet™, Polygesic™, Stagesic™, T-Gesic™, Ugesic™, Vanacet™, Vicodin®, Vicodin® ES, Vicodin® HP, Zydone®)
Acetaminophen; Oxycodone (Endocet™, Percocet®, Roxicet™, Roxilox™, Tylox®)
Acetaminophen; Propoxyphene (Darvocet® N, E-lor®, Genagesic®, Propacet® 100, Wygesic®)

# Main Index (1 of 4)


Alfentanil (Alfenta®)
Aspirin, ASA; Oxycodone (Percodan®, Percodan-Demi®, Roxiprin®)
Codeine
Fentanyl (Actiq™, Duragesic®, Oralet®, Sublimaze®)
Hydrocodone
Hydrocodone; Ibuprofen (Vicoprofen®)
Hydromorphone (Dilaudid®)
Meperidine (Demerol®)
Methadone (Diskets®, Dolophine®, Methadose®)
Morphine (Astramorph™PF, Duramorph®, Infumorph®, Kadian®, Morphelan®, MS Contin®, MSIR®, Oramorph®, Roxanol™)
Oxycodone (M-Oxy™, OxyContin®, OxyFast™, OxyIR®, Percolone™, Roxicodone®)
Propoxyphene (Darvon®)
Sufentanil (Sufenta®)
▶Salicylates
Acetaminophen; Aspirin, ASA; Caffeine (Excedrin® Extra Strength, Excedrin® Migraine, Goody's® Extra-Strength Headache Powders)
Aspirin, ASA (Aspergum®, Bayer®, Easprin®, Ecotrin®, Empirin®, Genprin®, Halfprin, ZORprin®)
Aspirin, ASA; Carisoprodol (Soma® Compound, Sodol® Compound)
Aspirin, ASA; Oxycodone (Percodan®, Percodan-Demi®, Roxiprin®)
Diflunisal (Dolobid®)
Salicylate Salts (Arthropan®, Trilisate®)
Salsalate (Arthra-G®, Disalcid®, Mono-Gesic®, Salflex®)
▶Anesthetics
Dexmedetomidine (Precedex™)
▶Benzodiazepines
Diazepam (Diastat®, Dizac™, Valium®)
Lorazepam (Ativan®)
Midazolam (Versed®)
▶General Anesthetics
Droperidol (Inapsine®)
Etomidate (Amidate®)
Ketamine (Ketalar®)
Nitrous Oxide
Propofol (Diprivan®)
▶*Barbiturates*
Methohexital (Brevital®)
Thiopental (Pentothal®)
▶*Halogenated anesthetics*
Enflurane (Ethrane®)
Halothane (Fluothane®)
Isoflurane (Forane®)
Methoxyflurane (Penthrane®)
Sevoflurane (Ultane®)
▶Local Anesthetics
▶*Amide local anesthetics*
Articaine; Epinephrine (Septocaine™)
Bupivacaine (Marcaine®, Sensorcaine®)
Etidocaine (Duranest®)
Levobupivacaine (Chirocaine®)
Lidocaine (Dentipatch®, Lidoderm®, Xylocaine®, Zilactin®-L)
Mepivacaine (Carbocaine®, Isocaine®, Polocaine®)
Prilocaine (Citanest®)
Ropivacaine (Naropin®)
▶*Ester local anesthetics*
Benzocaine (Americaine®, Hurricaine®, Orajel®, Zilactin®-B)

# Main Index (1 of 4)


Benzonatate (Tessalon Perles®)
Chloroprocaine (Nesacaine®)
Cocaine
Procaine (Novocain®)
Tetracaine (AK-T-Caine®, Cepacol® Viractin®, Pontocaine®, Opticaine®)
▸Opiate agonists
Alfentanil (Alfenta®)
Fentanyl (Actiq™, Duragesic®, Oralet®, Sublimaze®)
Sufentanil (Sufenta®)
▸Antihistamines
▸$H_1$-blockers
▸*Non-sedating $H_1$-blockers*
Astemizole (Hismanal®)
Fexofenadine (Allegra®)
Fexofenadine; Pseudoephedrine (Allegra-D®)
Loratadine (Claritin®)
Loratadine; Pseudoephedrine (Claritin-D®)
Terfenadine (Seldane®)
▸*Sedating $H_1$-blockers*
Azelastine (Astelin NS®, Optivar™)
Brompheniramine (Dimetane®, Dimetapp® Allergy, Nasahist B®, ND-Stat®, Oraminic II®)
Brompheniramine; Dextromethorphan; Phenylpropanolamine (Boca-Hist® DM, Delhistine® DM, Dimetapp® Cold & Cough, Dimetapp® DM Cold & Cough, Durahistine® DM, Highland® DM, Histinex® DM, Iohist® DM, Liqui-Histine® DM, Multihist® DM, Poly-DM®, Poly-Histine DM®, Prohistine-DM®, Trihist® DM, Uni-Multihist® DM)
Brompheniramine; Pseudoephedrine (Allent®, Bromadrine® TR, Bromfed®, Bromfed-PD®, Bromfenex®, Bromfenex® PD, Dallergy® Jr., Endafed®, Iofed®, Iofed® PD, Lodrane®, Lodrane® PD, M-Hist®, Respahist®, Rondec® Chewable Tablets, Touro® A&H, ULTRAbrom®, ULTRAbrom® PD)
Carbinoxamine; Dextromethorphan; Pseudoephedrine (Balamine® DM, Biodec® DM, Carbodec® DM, Carbodex® DM, Carbofed® DM, Cardec® DM, Chemdec® DM, Cydec® DM, Dura Ron® DM, Prodec® DM, Rondamine® DM, Rondec®-DM, Sildec® DM, Tussafed®, Tussafed® Pediatric)
Cetirizine (Zyrtec®)
Chlorpheniramine (Aller-Chlor®, Chlor-Trimeton®, Efidac® 24)
Chlorpheniramine; Hydrocodone (S-T Forte 2®, Tussionex®)
Chlorpheniramine; Hydrocodone; Pseudoephedrine (A-G Tussin®, Hexatuss®, Hexatussin®, Histinex® PV, Hyfed®, Hyphed®, KG-Tussin®, M-End®, No-Tuss®, P-V Tussin®, Pancof® HC, P-V Tussin®, Q-V Tussin®, Tussend® Tablets, Tussend® Syrup, Tussin-V®)
Clemastine (Tavist® Allergy)
Codeine; Promethazine (Phenergan® w/Codeine)
Cyproheptadine (Periactin®)
Dextromethorphan; Promethazine (Phenergan® w/Dextromethorphan, Prometh® w/Dextromethorphan, Promethazine® DM)
Diphenhydramine (Banophen®, Benadryl®, Diphedryl®, Simply Sleep™)
Hydrocodone; Pheniramine; Phenylephrine; Phenylpropanolamine; Pyrilamine (Ban Tuss® HC, logreen®, Q-Tuss® HC, Rolatuss® w/Hydrocodone, Statuss® Green, Vetuss® HC)
Hydroxyzine (Atarax®, Vistaril®, Vistazine®)
Promethazine (Phenergan®)
▸$H_2$-blockers
Cimetidine (Tagamet®)
Famotidine (Pepcid®, Mylanta-AR®)
Nizatidine (Axid®)
Ranitidine (Zantac®)
Ranitidine Bismuth Citrate (Tritec®)
▸Antiinfective Agents
Bacitracin (AK-Tracin®, Baci-IM®, Baci-RX®, Ocu-Tracin®)
Bismuth Subsalicylate (Bismatrol®, Pepto-Bismol®)
Chloramphenicol (Chloromycetin®)

# Main Index (1 of 4)


Clindamycin (Cleocin HCl®)
Metronidazole (Flagyl®, MetroCream®, MetroGel®, MetroLotion™, Noritate™)
Trimethoprim (Primsol™, Proloprim®, Trimpex®)
▶Aminoglycosides
Amikacin (Amikin®)
Gentamicin (Garamycin®, Gentacidin®, G-mycin®, Jenamicin®)
Neomycin (Mycifradin®, Myciguent®)
Spectinomycin (Trobicin®)
Streptomycin
Tobramycin (Nebcin®, TOBI®, Tobrex®)
▶Anthelmintics
Mebendazole (Vermox®)
Pyrantel (Antiminth®)
Quinacrine (Atabrine®)
Thiabendazole (Mintezol®)
▶Antifungals
Ciclopirox (Loprox®, Penlac™)
Flucytosine (Ancobon®)
Griseofulvin (Fulvicin®, Grifulvin V®, Grisactin®, Gris-PEG®)
Terbinafine (Lamisil®)
▶*Azole antifungals*
Clotrimazole (Gyne-Lotrimin®, Gynix™, Lotrimin®, Mycelex®, Trivagizole®)
Fluconazole (Diflucan®)
Itraconazole (Sporanox®)
Ketoconazole (Nizoral®, Nizoral® A-D)
Miconazole (Cruex® Miconazole, Desenex® Miconazole, M-Zole®, Micatin®, Monistat®)
Terconazole (Terazol®)
Tioconazole (Vagistat®)
▶*Polyene antifungals*
Amphotericin B (Amphocin®, Fungizone®)
Amphotericin B Lipid Formulations (Abelcet®, AmBisome®, Amphotec®)
Nystatin (Mycostatin®, Nilstat®, Nyotran™, Nystex®, Nystop®)
▶Antimycobacterials
Clofazimine (Lamprene®)
▶*Antituberculosis agents*
Cycloserine (Seromycin®)
Ethambutol (Myambutol®)
Isoniazid, INH (INH™, Nydrazid®)
Pyrazinamide, PZA
Rifabutin (Mycobutin®)
Rifampin (Rifadin®, Rimactane®)
Rifapentine (Priftin®)
▶Antiprotozoals
Dapsone
Pentamidine (Pentacarinat®, Pentam®, NebuPent™)
Trimetrexate (Neutrexin®)
▶*Antimalarials*
Atovaquone (Mepron®)
Atovaquone; Proguanil (Malarone®)
Chloroquine (Aralen®)
Hydroxychloroquine (Plaquenil®)
Mefloquine (Lariam®)
Primaquine
Pyrimethamine (Daraprim®)
Quinine
▶Antivirals
Acyclovir (Zovirax®)

# Main Index (1 of 4)


Amantadine (Symmetrel®)
Cidofovir (Forvade®, Vistide®)
Docosanol (Abreva™, Lidakol™)
Famciclovir (Famvir®)
Fomivirsen (Vitravene™)
Foscarnet (Foscavir®)
Ganciclovir (Cytovene®, Vitrasert®)
Penciclovir (Denavir®)
Ribavirin (Virazole®)
Rimantadine (Flumadine®)
Valacyclovir (Valtrex®)
Vidarabine (Vira-A®)
▶ *Alpha interferons*
Interferon Alfa-2a (Roferon® A)
Interferon Alfa-2b (Intron® A)
Interferon Alfa-2b; Ribavirin (Intron® A, Rebetol®, Rebetron™)
Interferon Alfa-n1 (Wellferon®)
Interferon Alfa-n3 (Alferon®)
Interferon Alfacon-1 (Infergen®)
▶ *Anti-retroviral protease inhibitors*
Amprenavir (Agenerase™)
Indinavir (Crixivan®)
Lopinavir; Ritonavir (Kaletra™)
Nelfinavir (Viracept™)
Ritonavir (Norvir®)
Saquinavir (Fortovase™, Invirase™)
▶ *Anti-retroviral reverse transcriptase inhibitors*
Abacavir (Ziagen™)
Delavirdine (Rescriptor®)
Didanosine, ddI (Videx®, Videx® EC)
Efavirenz (Sustiva™)
Lamivudine, 3TC (Epivir®, Epivir®-HBV™)
Lamivudine, 3TC; Zidovudine, ZDV (Combivir®)
Nevirapine (Viramune®)
Stavudine, d4T (Zerit®)
Zalcitabine, ddC (Hivid®)
Zidovudine, ZDV (Retrovir®)
▶ *Immunoglobulins*
Cytomegalovirus Immune Globulin, CMV-IGIV (CytoGam®)
Palivizumab (Synagis™)
Respiratory Syncytial Virus Immune Globulin, RSV-IGIV (RespiGam™)
▶ *Neuraminidase inhibitors*
Oseltamivir (Tamiflu™)
Zanamivir (Relenza®)
▶ Carbacephems
Loracarbef (Lorabid®)
▶ Carbapenems
Imipenem; Cilastatin (Primaxin®)
Meropenem (Merrem®)
▶ Cephalosporins
▶ *First-generation cephalosporins*
Cefadroxil (Duricef®, Ultracef®)
Cefazolin (Ancef®, Kefzol®)
Cephalexin (Keflex®, Keftab®)
Cephalothin (Keflin®)
Cephradine (Anspor®, Velosef®)
▶ *Second-generation cephalosporins*

# Main Index (1 of 4)


Cefaclor (Ceclor®)
Cefotetan (Cefotan®)
Cefoxitin (Mefoxin®)
Cefprozil (Cefzil®)
Cefuroxime (Ceftin®, Kefurox®, Zinacef®)
▶ *Third-generation cephalosporins*
Cefdinir (Omnicef®)
Cefixime (Suprax®)
Cefoperazone (Cefobid®)
Cefotaxime (Claforan®)
Cefpodoxime (Banan®, Vantin®)
Ceftazidime (Ceptaz®, Fortaz®, Tazicef®, Tazidime®)
Ceftibuten (Cedax®)
Ceftizoxime (Cefizox®)
Ceftriaxone (Rocephin®)
▶ *Fourth-generation cephalosporins*
Cefepime (Maxipime®)
▶Glycopeptides
Vancomycin (Vancocin®)
▶Macrolides
Amoxicillin; Clarithromycin; Lansoprazole (Prevpac®)
Azithromycin (Zithromax®)
Clarithromycin (Biaxin®, Biaxin® XL)
Dirithromycin (Dynabac®)
Erythromycin (A/T/S®, Akne-Mycin®, E-Mycin®, E.E.S.®, Emgel®, ERYC®, Erycette®, EryDerm®, Erygel®, Erymax®, EryPed®, Ery-Tab®, Erythrocin®, Erythromycin Base Filmtab®, Erythrostatin®, Ilosone®, Ilotycin®, PCE®, Staticin®, T-Stat®, Theramycin Z®, Erythromycin by Mylan, Erythromycin DR by Abbott)
Erythromycin; Sulfisoxazole (Eryzole®, Pediazole®)
▶Monobactams
Aztreonam (Azactam®)
▶Oxazolidinones
Linezolid (Zyvox™)
▶Penicillins
Penicillin G (Bicillin®, Pfizerpen®, Wycillin®)
Penicillin V (Pen-Vee® K, V-Cillin-K®, Veetids®)
▶ *Aminopenicillins*
Amoxicillin (Amoxil®, Wymox®, Trimox®)
Amoxicillin; Clarithromycin; Lansoprazole (Prevpac®)
Ampicillin (Omnipen®, Polycillin®, Principen®)
▶ *Extended-spectrum penicillins*
Amoxicillin; Clavulanic Acid (Augmentin®)
Ampicillin; Sulbactam (Unasyn®)
Carbenicillin (Geocillin®)
Mezlocillin (Mezlin®)
Piperacillin (Pipracil®)
Piperacillin; Tazobactam (Zosyn®)
Ticarcillin (Ticar®)
Ticarcillin; Clavulanic Acid (Timentin®)
▶ *Penicillinase-resistant penicillins*
Dicloxacillin (Dynapen®, Dycill®, Pathocill®)
Nafcillin (Unipen®)
Oxacillin (Bactocill®, Prostaphlin®)
▶Polymyxins
Polymyxin B
▶Quinolones
Ciprofloxacin (Cipro®, Ciloxan®)

# Main Index (1 of 4)


Gatifloxacin (Tequin™)
Grepafloxacin (Raxar™)
Levofloxacin (Levaquin™, Quixin™)
Lomefloxacin (Maxaquin®)
Moxifloxacin (Avelox™)
Norfloxacin (Chibroxin®, Noroxin®)
Ofloxacin (Floxin®, Ocuflox®)
Sparfloxacin (Zagam®)
Trovafloxacin, Alatrofloxacin (Trovan™)
▶Scabicides
Lindane (Kildane®, Kwell®, Scabene®)
Permethrin (Acticin™, Elimite®, Nix®)
▶Streptogramins
Dalfopristin; Quinupristin (Synercid®)
▶Sulfonamides
Erythromycin; Sulfisoxazole (Eryzole®, Pediazole®)
Sulfacetamide (Bleph-10®, Klaron®, Sulfair®, Sebizon®, Isopto Cetamide®, Sodium Sulamyd®)
Sulfadiazine
Sulfamethoxazole (Gantanol®)
Sulfamethoxazole; Trimethoprim, SMX-TMP (Bactrim®, Septra®)
Sulfasalazine (Azulfidine®)
Sulfisoxazole (Gantrisin®)
▶Tetracyclines
Demeclocycline (Declomycin®)
Doxycycline (Atridox™, Doryx®, Doxy®, Monodox®, Periostat®, Vibramycin®)
Minocycline (Dynacin®, Minocin®, Vectrin®)
Tetracycline (Actisite®, Sumycin®, Topicycline®)
▶Urinary Antiinfectives
Fosfomycin (Monurol®)
Methenamine (Hiprex®, Urex®, Mandameth®, Mandelamine®)
Nitrofurantoin (Furadantin®, Macrodantin®, Macrobid®)
▶Antineoplastic Agents
▶Alkylating Agents
Altretamine (Hexalen®)
Busulfan (Busulfex™, Myleran®)
Dacarbazine, DTIC (DTIC-Dome®)
Procarbazine (Matulane®)
Temozolomide (Temodar®)
Thiotepa (Thioplex®)
▶*Nitrogen mustards*
Chlorambucil (Leukeran®)
Cyclophosphamide (Cytoxan®, Neosar®)
Estramustine (Emcyt®)
Ifosfamide (Ifex®)
Mechlorethamine, Nitrogen Mustard (Mustargen®)
Melphalan (Alkeran®)
▶*Nitrosoureas*
Carmustine, BCNU (BiCNU®, Gliadel®)
Lomustine, CCNU (CeeNU®)
Streptozocin (Zanosar®)
▶*Platinum compounds*
Carboplatin (Paraplatin®)
Cisplatin (Platinol®)
▶Anthracenediones
Mitoxantrone (Novantrone®)
▶Antimetabolites
Hydroxyurea (Droxia®, Hydrea®)

# Main Index (1 of 4)


- ▶ *Folate analogs*
  - Methotrexate (Rheumatrex®)
- ▶ *Purine analogs*
  - Cladribine (Leustatin®)
  - Fludarabine (Fludara®)
  - Mercaptopurine, 6-MP (Purinethol®)
  - Pentostatin (Nipent®)
  - Thioguanine, 6-TG
- ▶ *Pyrimidine analogs*
  - Capecitabine (Xeloda™)
  - Cytarabine, ARA-C (Cytosar-U®, DepoCyt™)
  - Floxuridine (FUDR®)
  - Fluorouracil, 5-FU (Adrucil®, Efudex®, Fluoroplex®)
  - Gemcitabine (Gemzar®)
- ▶ Biologic Response Modifiers
  - Bacillus Calmette-Guerin Vaccine, BCG (PACIS®, TheraCys®, TICE® BCG)
  - Denileukin Deftitox (Ontak®)
- ▶ *Alpha interferons*
  - Interferon Alfa-2a (Roferon® A)
  - Interferon Alfa-2b (Intron® A)
- ▶ *Interleukins*
  - Aldesleukin, IL-2 (Proleukin®)
- ▶ *Monoclonal antibodies*
  - Alemtuzumab (Campath®)
  - Gemtuzumab Ozogamicin (Mylotarg™)
  - Rituximab (Rituxan®)
  - Trastuzumab (Herceptin®)
- ▶ Natural Antineoplastics
  - Asparaginase, Pegaspargase (Elspar®, Oncaspar®)
- ▶ *Anthracyclines*
  - Daunorubicin (Cerubidine®)
  - Daunorubicin Liposomal (DaunoXome®)
  - Doxorubicin (Adriamycin®, Rubex®)
  - Doxorubicin Liposomal (Caelyx®, Doxil®, Evacet™)
  - Epirubicin (Ellence™)
  - Idarubicin (Idamycin®)
  - Valrubicin (Valstar™)
- ▶ *Antitumor antibiotics*
  - Bleomycin (Blenoxane®)
  - Dactinomycin, Actinomycin D (Cosmegen®)
  - Mitomycin (Mutamycin®)
  - Plicamycin (Mithracin®)
- ▶ *Camptothecin analogs*
  - Irinotecan (Camptosar®)
  - Topotecan (Hycamtin®)
- ▶ *Epipodophyllotoxins*
  - Etoposide, VP-16 (Etopophos®, Toposar®, VePesid®)
  - Teniposide (Vumon®)
- ▶ *Taxanes*
  - Docetaxel (Taxotere®)
  - Paclitaxel (Paxene®, Taxol®)
- ▶ *Vinca alkaloids*
  - Vinblastine (Velban®)
  - Vincristine (Oncovin®)
  - Vinorelbine (Navelbine®)
- ▶ Photosensitizing Agents
  - Porfimer (Photofrin®)

Figure 1. Systems Model: Timely administration of IV antibiotics in CAP patients