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Processes of care for community-acquired pneumonia

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One of the primary goals of physicians treating patients with community-acquired pneumonia (CAP) is to improve patient outcomes. Achieving a good outcome depends on the medical care or process of care that the patient receives and certain patient-pneumonia characteristics that are present at the time of diagnosis. The key patient-pneumonia characteristics and key processes of care that impact outcomes, and the most important outcomes in patients with CAP are depicted in Table 1.

Evaluation of quality of care in patients with CAP can be performed by measuring the processes of care or the outcomes of care. Although CAP outcomes frequently have been used to evaluate the quality of care delivery, using outcomes to evaluate local care over time or to benchmark care among different institutions requires the tremendous task of adjusting for the patient-pneumonia characteristics that may influence outcomes. Compared with the values from past years, a hospital may identify an increased length of stay and higher mortality rates among hospitalized patients with CAP. This deterioration of outcomes may be explained by a deterioration in a process of care (eg, poor antibiotic selection), but it also may be explained by a change in the characteristics of patients who were admitted to the hospital (eg, patients with more severe pneumonia).

Performance of a quality assessment by evaluating CAP process of care, rather than CAP outcomes, is recommended. There are several reasons for the emphasis on processes of care. By improving processes of care, clinical outcomes can be improved. Processes of care can be measured easily at the local level through the use of process-of-care indicators. Because processes of care are not influenced by patient characteristics, they can be used to

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Table 1
Primary patient–community-acquired pneumonia characteristics and processes of care that influence outcomes of care

CAP characteristics	Processes of care	Outcomes of care
Host immune status	Diagnosis of CAP	Clinical improvement
Host mental status	Hospitalization	Clinical failure
Host nutritional status	Respiratory isolation	Mortality
Host renal function	Microbiologic workup	Time to clinical stability
Host cardiac function	Oxygen therapy	Length of hospitalization
CAP cause	Antibiotic therapy	Relapse of CAP
CAP with bacteremia	Switch therapy	Re-hospitalization
CAP multilobar	Hospital discharge	Patient satisfaction
CAP with empyema	Prevention of CAP	Cost of care

define quality over time and to benchmark institutions without adjusting for severity of disease. Each process of care has a recommended goal and rationale behind achieving this goal, making it a useful tool for educating physicians regarding the optimal management of patients with CAP.

To improve outcomes in patients with CAP, several medical societies have published recommendations for improving processes of care and have suggested indicators to evaluate particular processes [1–3]. A clear and concise recommended course of action is important for each process of care. Although there is a consensus among CAP guidelines regarding the processes of care that are important, there are also disagreements regarding some recommended courses of action. Disagreements regarding how to best improve some processes mostly result from the lack of good scientific evidence in certain areas of CAP management.

For each process of care, I review the most important recommended courses of action, the rationale for the recommendation, and how to evaluate the process at the local level using process-of-care indicators. International data on process-of-care indicators in hospitalized patients with CAP from the Community-Acquired Pneumonia Organization (CAPO) international cohort study are presented. In this study, investigators perform worldwide benchmarking on processes of care by dividing the participating countries into four regions: North America (region I), Europe (region II), Latin America (region III), and Asia and Africa (region IV). At the time of publication, there were more than 2000 patients in the CAPO database. A copy of the data-collection form that is being used to abstract information on process-of-care indicators can be found at http://www.caposite.com. A brief review about improving processes of care at the local-hospital level is presented.

Diagnosis of community-acquired pneumonia

Recommended course of action

Hospitalized patients with CAP should undergo a chest radiograph, which should document a new pulmonary infiltrate [1–4].

Rationale for recommendation

Because of low sensitivity and specificity, history and physical examination are considered suboptimal measures for confirming or excluding a diagnosis of CAP. If the diagnosis is based only on history and physical examination, a significant number of patients will be misdiagnosed with CAP. The use of antibiotics in patients with a misdiagnosis of CAP may produce negative outcomes associated with unnecessary antibiotic use. The goal of the recommendation is to improve quality of care by preventing errors in diagnosis, because patients with an alternative diagnosis will not benefit from the processes of care for patients with CAP.

Process-of-care indicator

The proportion of hospitalized patients with a clinical diagnosis of CAP and a new pulmonary infiltrate on chest radiograph can be used as a process-of-care indicator. For this indicator, the numerator is the number of patients diagnosed with CAP that have a new pulmonary infiltrate, and the denominator is the number of patients hospitalized with a diagnosis of CAP [2].

International data

In the CAPO international cohort study, the diagnostic criteria for CAP are the presence of a new pulmonary infiltrate on chest radiograph plus at least one of the following: cough, fever, hypothermia, leukocytosis, or leukopenia. Among patients admitted to the hospital with a clinical diagnosis of CAP, a new pulmonary infiltrate was found at the time of hospitalization in 86%, and a new pulmonary infiltrate was found during the first 24 hours after admission in 1% [5]. Considering the recommended course of action for CAP diagnosis, the diagnosis could not be confirmed in 13% of hospitalized patients [5]. These data suggest that overdiagnosis of CAP and the consequent unnecessary use of antibiotics may be a common international occurrence in hospitalized patients with a clinical diagnosis of CAP. The literature indicates that a patient with signs and symptoms of pneumonia may have a negative chest radiograph at the time of hospitalization because of early clinical presentation or dehydration. Data from the CAPO study indicate that this clinical scenario is rare and occurs in only 1% of hospitalized patients with CAP [5].

Other recommended courses of action

In the area of diagnosis of CAP, it is also recommended to evaluate if the patient has a history of recent hospitalization. Patients who are admitted from home but had been discharged from the hospital during the previous 2 weeks should be considered to have hospital-acquired pneumonia. The distinction between hospital-acquired pneumonia and CAP is important for the selection of initial empiric antimicrobial therapy. Data from the CAPO

study indicate that a misdiagnosis of CAP as a result of a history of recent hospitalization occurred in 2% of hospitalized patients with pneumonia [5].

Hospitalization

Recommended course of action

The risk for mortality should be calculated using the pneumonia severity index (PSI). Patients with a high risk for mortality (risk classes III, IV, and V) should be hospitalized. Patients with a low risk for mortality (risk classes I and II) can be treated as outpatients unless the physician's clinical judgement indicates that the patients are not suitable for outpatient therapy [1–3].

Rationale for recommendation

During the initial evaluation of patients with CAP, physicians tend to overestimate the risk for mortality. Misjudgment of mortality risk is associated with unnecessary hospitalization. Calculation of mortality risk using the PSI may avoid unnecessary hospitalization in patients with a low risk for mortality. Although the PSI is a good predictor of mortality risk at the time of hospitalization, it should not be used alone to determine the need for hospital admission. Because the PSI does not take into consideration the need for hospital care of decompensated comorbidities and the psychosocial contraindications for outpatient therapy, a number of patients with CAP will be hospitalized even though they have a low mortality risk. The goal of the recommendation is to improve quality of care by preventing unnecessary hospitalization.

Process-of-care indicator

The proportion of patients with appropriate hospitalization according to risk class can be used as a process-of-care indicator. For this indicator, the numerator is the number of patients hospitalized with risk class III, IV, or V, and the denominator is the total number of hospitalized patients with CAP.

International data

In the CAPO study, 9% of patients were in risk class I, 18% were in risk class II, 22% were in risk class III, 35% were in risk class IV, and 16% were in risk class V. Even though 27% of the hospitalized patients had a low risk for mortality (risk classes I and II), most of these patients had a reason that warranted hospitalization. The most common reasons justifying hospitalization were treatment of coexisting medical conditions and failure of outpatient antibiotic therapy. Although the PSI can help physicians decide which patients will benefit from hospitalization, the PSI by itself cannot be used to define the appropriateness of hospitalization [6].

In the CAPO study, patients with CAP and HIV infection were hospitalized with a low PSI. More than 60% of hospitalized patients with CAP and HIV infection belonged to the risk classes I and II. Although the primary reason for the hospitalization of these patients was the consideration of HIV infection as a risk factor for a complicated course, in a case-controlled study we were not able to document any differences in clinical outcomes among hospitalized patients with CAP and with or without HIV infection [7].

Other recommended courses of action

The American Thoracic Society (ATS) published a list of criteria that are associated with a complicated course and poor outcome in patients with CAP. Hospitalization of patients with multiple risk factors for complicated course is recommended [1].

The following five risk factors for mortality have been identified in patients with CAP: confusion, urea level greater than 19 mg/dL, respiratory rate of at least 30 breaths/min, low blood pressure (systolic pressure, <90 mm Hg; diastolic pressure, <60 mm Hg), and age greater than 65 years. These risk factors are referred to as the CURB-65 [4]. Patients should be evaluated for the presence of CURB-65 risk factors, and patient with more than one of these risk factors should be hospitalized [4].

Respiratory isolation

Recommended course of action

Patients admitted for CAP should be screened for the presence of risk factors for pulmonary tuberculosis (TB). Patients with such risk factors should be placed in respiratory isolation until TB has been ruled out [1–3].

Rationale for recommendation

Patients with pulmonary TB should be placed in isolation at the time of hospitalization to prevent transmission to other patients and healthcare personnel. Because TB can present with a clinical picture of acute or chronic pneumonia, a high index of suspicion for TB should be maintained in hospitalized patients with a clinical diagnosis of CAP. The goal of the recommendation is to prevent nosocomial transmission of TB.

Process-of-care indicator

The proportion of patients placed in respiratory isolation can be used as a process-of-care indicator. For this indicator, the numerator is the number of patients placed on isolation, and the denominator is the number of hospitalized patients with CAP TB and risk factors for pulmonary TB.

International data

The Centers for Disease Control and Prevention (CDC) have reported a series of risk factors for TB [8]. A diagnosis of TB should be considered in patients at high risk for infection with *Mycobacterium tuberculosis*, patients at high risk for progression of TB, and patients presenting with symptoms or chest radiograph abnormalities that are compatible with TB. Hospitalized patients in the CAPO study were evaluated for the presence of the CDC risk factors for pulmonary TB, as described in Box 1. The presence of at least one risk factor for TB was found in 88% of patients in North America, 80% of patients in Europe, 82% of patients in Latin America, and 97% of patients in Asia and Africa [9]. These data indicate that the CDC risk factors for TB are too sensitive to identify patients with CAP who are at risk for TB. A multivariate analysis of hospitalized patients with CAP and TB

Box 1. Centers for Disease Control and Prevention risk factors for tuberculosis that were evaluated in the Community-Acquired Pneumonia Organization international cohort study

Risk factors for latent TB
- Homelessness
- Community living (eg, prision)
- Alcohol or drug abuse
- Employment as healthcare worker

Risk factors for progression to active TB
- Previous history of TB
- Age greater than 65 years
- Gastrectomy
- Silicosis
- Long-term steroid therapy
- Leukemia or lymphoma
- Other immunosuppressive state
- Recent exposure to TB case
- Intestinal bypass
- Diabetes mellitus
- End-stage renal disease
- Cancer of the gastrointestinal tract
- HIV or AIDS

Risk factors for active TB
- Hemoptysis
- Weight loss
- Upper lobe infiltrate
- Night sweats
- History of positive PPD

indicated that the primary risk factors for TB are: (1) a past medical history of TB, (2) HIV infection, (3) pneumonia associated with significant weight loss, and (4) a history of night sweats [10].

Other recommended courses of action

In addition to TB, other causes of CAP can be transmitted from patient to patient or healthcare workers. Hospitalized patients with CAP should be evaluated for recent travel to a severe acute respiratory syndrome (SARS)-affected area. A travel history during the 10 days before the onset of symptoms should be matched to the CDC report of areas where SARS has been identified (http://www.cdc.gov). Appropriate isolation precautions should be instituted for hospitalized patients with CAP and recent travel to a SARS-affected area.

Hospitalized patients with influenza pneumonia can transmit the disease to other patients or healthcare workers. If an epidemic of influenza is documented in the local community, patients at risk for influenza pneumonia should be placed in respiratory isolation until influenza is ruled out.

Microbiologic workup

Recommended course of action

Hospitalized patients with CAP should have a sputum specimen for gram's stain and culture, and two sets of blood cultures should be obtained before the institution of antimicrobial therapy [1–3].

Rationale for recommendation

Defining the cause of pneumonia may have significant implications for patient management. In hospitalized patients with pneumonia who clinically deteriorate, the initial microbiologic workup may identify a resistant or unusual organism that was not covered with the original empiric therapy. In this scenario, defining the cause of pneumonia will help with the selection of alternative therapy and improve clinical outcome. In patients who clinically improve, knowing the cause of CAP may enable use of pathogen-directed therapy or de-escalation of therapy.

Process-of-care indicator

The proportion of patients who undergo blood culture before the administration of antibiotic therapy can be used as a process-of-care indicator. For this indicator, the numerator is the number of patients with two blood cultures that were obtained before administration of antibiotic, and the denominator is the number of patients in whom blood cultures were obtained [2].

International data

Data from the CAPO study indicate that a microbiologic workup consisting of sputum and blood cultures was performed in only 63% of hospitalized patients with CAP [11]. In 9% of blood cultures obtained at the time of hospitalization, an organism was identified. The most common identified organism was *Streptococcus pneumoniae*, which was found in 60% of positive blood cultures. Considering the current standard of practice, only 12% of hospitalized patients with CAP are candidates for pathogen-directed therapy [11]. The low yield of sputum and blood cultures has been offered as proof that microbiologic workup is not cost effective in most hospitalized patients with CAP [12,13]. This also explains the disagreements among medical societies in regard to the need and extent of initial microbiologic workup in these patients [1–4].

Other recommended courses of actions

Besides the identification of typical pathogens through sputum and blood cultures, an extended microbiologic workup has been recommended for some hospitalized patients with CAP. The urinary antigen test for detecting *Legionella pneumophila* is recommended in hospitalized patients with severe CAP, because identification of *L pneumophila* may alter antibiotic selection [1–4]. Sputum for acid-fast bacillus smear and culture should be obtained in patients at risk for pulmonary TB to adjust therapy accordingly.

Oxygen therapy

Recommended course of action

At the time of admission, clinicians should determine the arterial oxygen saturation in hospitalized patients with CAP to define the need for oxygen therapy [1–4].

Rationale for recommendation

The primary defect in lung physiology produced by CAP is an abnormal ventilation/perfusion (V/Q) ratio. The alveolar inflammatory reaction caused by CAP produces areas in the lung with perfusion but without ventilation. According to the severity of V/Q abnormality, some patients may develop arterial hypoxemia. Severe complications of pneumonia, such as cardiac arrhythmias or myocardial infarction, are more likely to occur in patients with decreased arterial oxygen saturation and decreased oxygen delivery to peripheral tissues. Hospitalized patients with CAP should have an assessment of oxygenation by pulse oximetry. Supplemental oxygen therapy to maintain oxygen saturation above 90% is an important treatment strategy in hospitalized patients with CAP. The goal of this

recommendation is to prevent any organ dysfunction that may develop as a consequence of poor oxygen delivery to peripheral tissue.

Process-of-care indicator

The proportion of patients with CAP who undergo an assessment of gas exchange at hospital admission can be used as a process-of-care indicator. For this indicator, the numerator is the number of patients with assessment of gas exchange by pulse oximetry or arterial blood gas at hospital admission, and the denominator is the number of hospitalized patients with CAP [2].

International data

Data from the CAPO study indicate that assessment of oxygenation at hospital admission was performed in 79% of hospitalized patients with CAP. Determination of oxygen saturation by pulse oximetry was used in only 64% of patients.

Other recommended courses of action

Measurement of arterial blood gas should be obtained in hospitalized patients with CAP and chronic obstructive pulmonary disease (COPD) who required oxygen therapy to evaluate for carbon-dioxide retention. The goal of this recommendation is to prevent the decreased respiratory drive that may occur in patients with COPD receiving oxygen therapy [1–4].

Empiric therapy

Recommended course of action

Hospitalized patients with CAP should be treated with an empiric antibiotic regimen that treats infection with typical and atypical pathogens [1–4].

Rationale for recommendation

A series of core organisms should be considered as potential pathogens in hospitalized patients with CAP. These organisms include *S pneumoniae*, *Mycoplasma pneumoniae*, *Chlamydia pneumoniae*, and *L pneumophila*. Because an initial empiric regimen that treats infection caused by the list of core organisms has been associated with better patient outcomes, several societies recommend such a regimen for all hospitalized patients with CAP [1–3]. The goal of this recommendation is to improve clinical outcome by using appropriate initial empiric therapy.

Process-of-care indicator

The proportion of hospitalized patients with CAP who are treated with empiric therapy according to national societies' recommendations can be

used as a process-of-care indicator. For this indicator, the numerator is the number of hospitalized patients with CAP who were treated with empiric therapy in agreement with the recommendations, and the denominator is the number of hospitalized patients with CAP.

International data

Data from the CAPO study indicate that initial empiric therapy for infections caused by typical and atypical pathogens was used in 88% of patients in North America, 77% of patients in Europe, 55% of patients in Latin America, and 47% of patients in Asia and Africa. Compared with patients who did not receive an initial empiric regimen that treated infections caused by typical and atypical pathogens, patients who did receive such a regimen had a decreased time to clinical improvement (3.7 versus 3.1 days; $P < 0.001$), a decreased length of hospitalization (6.9 versus 5.9 days; $P < 0.001$), and lower mortality rate (10.1% versus 6.0%; $P < 0.01$) [14]. Among patients who received a third-generation nonantipseudomonal cephalosporin (eg, ceftriaxone, cefotaxime), those who also received a macrolide (eg, clarithromycin, azithromycin) had a decreased length of hospital stay and a lower mortality rate [15].

Other recommended courses of action

Hospitalized patients with CAP promptly should begin empiric therapy, because delay in antibiotic treatment is associated with poor outcome [1–3]. Time to initiation of antibiotic therapy after hospital arrival is suggested as a process-of-care indicator [2].

Switch therapy

Recommended course of action

Hospitalized patients with CAP should be switched from intravenous to oral antibiotics as soon as they reach clinical stability [1–4].

Rationale for recommendation

Once a patient is clinically stable, it is safe to switch from intravenous to oral therapy. Switch therapy can be performed even in patients with documented pneumococcal bacteremia at the time of hospital admission [1]. The early switch from intravenous to oral antibiotics is associated with decreased cost of care because of the resultant earlier hospital discharge and may prevent the development of intravenous line infection.

Process-of-care indicator

The proportion of patients in whom appropriate switch therapy was performed can be used as a process-of-care indicator. For this indicator, the

numerator is the number of hospitalized patients with CAP in whom switch therapy was performed, and the denominator is the number of hospitalized patients with CAP who were candidates for switch therapy.

International data

The CAPO study protocol used the ATS suggested criteria to define switch-therapy candidates. Candidates meet the following criteria: (1) adequate oral intake and gastrointestinal absorption, (2) improvement in cough and shortness of air, (3) afebrile condition for at least 8 hours, and (4) normalizing white blood cell count. Data from the CAPO study indicate that 67% of hospitalized patients with CAP were candidates for switch therapy during the first 7 days of hospitalization [16]. The switch to oral antibiotics was performed in 92% of switch-therapy candidates. These data indicate that switching therapy once patients reach clinical stability is a well-established international standard of practice.

Other recommended courses of action

It may not be necessary to wait until the patient has fulfilled the four criteria to discontinue intravenous therapy. The switch in therapy can be performed in patients with good oral intake and clinical improvement of pulmonary status, regardless of temperature or white blood cell count. A number of patients with nonsevere CAP are hospitalized primarily to treat decompensate comorbidities or because of social reasons. These patients can be treated with oral antibiotic therapy at the time of hospitalization.

Hospital discharge

Recommended course of action

Hospital discharge should occur the day that the patient reaches clinical stability if there is no need to treat a comorbidity, conduct further diagnostic workup, or attend to social needs [1].

Rationale for recommendation

Duration of hospitalization is the primary determinant of cost in hospitalized patients with CAP. Because there is no need for hospital observation of oral antibiotic treatment, the criteria for determining the use of switch therapy can be used for determining hospital discharge. It should be kept in mind that a proportion of patients with CAP that reach clinical stability may still require in-hospital care. Hospitalization may be beneficial for clinically stable patients with pulmonary infection who also require treatment of another medical condition or have social factors. The goal of this recommendation is to decrease cost of therapy by avoiding unnecessary hospital stay in patients who

safely can be discharged. Another goal is the improvement of quality of care by preventing inappropriate hospital discharge of patients who, despite receiving oral antibiotic treatment, still would benefit from hospital care.

Process-of-care indicator

The proportion of patients with an appropriate length of hospital stay can be used as a process-of-care indicator. For this indicator, the numerator is the number of hospitalized patients in whom appropriate length of hospital stay was documented, and the denominator is the number of hospitalized patients with CAP.

International data

The CAPO study protocol uses the ATS suggested criteria to define candidates for hospital discharge [1]. These candidates fulfill the following criteria: (1) achievement of clinical stability, (2) no need to treat comorbidities, (3) no need for further diagnostic workup, and (4) no social needs. Among patients who reached clinical stability and were switched to oral therapy, 51% remained hospitalized because of conditions unrelated to pneumonia [17]. Data from the CAPO study indicate that appropriate hospital discharge occurred in 80% of hospitalized patients with CAP who met discharge criteria.

Other recommended courses of action

Performance of a chest radiograph should not be repeated before hospital discharge, because improvement of pulmonary infiltrate occurs several days after clinical improvement. A chest radiograph should be done 4 to 6 weeks after hospital discharge to document resolution of pulmonary infiltrate, establish a new baseline, and exclude the possibility of a pulmonary mass that initially was masked by the pulmonary infiltrate.

Prevention of community-acquired pneumonia

Recommended course of action

All hospitalized patients with CAP should be evaluated for pneumococcal vaccine, influenza vaccine, and smoking cessation [1–4].

Rationale for recommendation

Pneumococcal vaccination is indicated for adults aged 65 and older and adults of any age who are at risk for CAP [1–4]. Patients with a history of previous hospitalization for CAP are at high risk for CAP recurrence. Hospitalized patients with CAP can be considered candidates for prevention

with pneumococcal vaccination. The pneumococcal vaccine has been shown to prevent pneumococcal pneumonia in young adults and to prevent more severe disease in the elderly. During epidemics of influenza, CAP frequency increases as a result of primary influenza pneumonia and secondary bacterial pneumonia complicating a case of influenza. Influenza vaccine is effective in limiting the severity of disease caused by the influenza virus. In hospitalized patients with CAP, there is no contraindication for the simultaneous administration of the pneumococcal vaccine and influenza vaccine at different sites [1].

Because smoking is a risk factor for the acquisition of pneumonia, smokers who are hospitalized with CAP should be enrolled in a smoking-cessation program to prevent future episodes of pneumonia.

Process-of-care indicators

The proportion of patients who are evaluated for pneumococcal vaccination or who undergo vaccination can be used as a process-of-care indicator. For this indicator the numerator is the total number of patients evaluated for or who undergo vaccination, and the denominator is the total number of patients discharged with CAP.

The proportion of patients who are evaluated for influenza vaccine or who undergo vaccination can be used as a process-of-care indicator. For this indicator the numerator is the total number of patients evaluated for or who undergo vaccination, and the denominator is the total number of patients discharged with CAP. The goal of this recommendation is to improve quality of care by preventing influenza and its complications.

The proportion of patients who are offered smoking-cessation counseling also can be used as a process-of-care indicator. For this indicator, the numerator is the number of smokers who were offered this counseling, and the denominator is the number of smokers who were discharged with CAP.

International data

Data from the CAPO study indicate that most prevention strategies are used infrequently in all regions of the world [18]. The percentage of patients with CAP who were evaluated for pneumococcal vaccination or who underwent vaccination was 15% in North America, 9% in Europe, 18% in Latin America, and 0% in Asia and Africa. The percentage of patients with CAP who were evaluated for influenza vaccination or who underwent vaccination was 14% in North America, 24% in Europe, 25% in Latin America, and 0% in Asia and Africa. The percentage of patients who were offered smoking-cessation counseling was 33% in North America, 81% in Europe, 23% in Latin America, and 0% in Asia and Africa. According to the CAPO study, prevention of CAP is the process of care with the greatest need for improvement.

Other recommended courses of action

Patients who are hospitalized during the influenza season are considered at risk for acquiring influenza from an infected healthcare worker. The vaccination of healthcare workers is an important strategy for the prevention of influenza in hospitalized patients. The level of influenza vaccination among healthcare workers has been suggested as a CAP prevention indicator [19].

Improving processes of care

Data from the CAPO study indicate that the quality of pneumonia care needs to be improved in adults from all regions of the world. The primary processes of care that need to be improved are prevention, diagnosis, and treatment.

Continuous quality improvement can improve these processes at the local-hospital level [20]. This methodology can be summarized in three steps: (1) collection of data on process-of-care indicators, (2) evaluation of variance from recommended care, and (3) development of local interventions for process improvement. A brief review for each of these steps is given.

Process-of-care indicators

Data from process-of-care indicators reflect the actual care delivered to patients with CAP. The data should be presented in a format that clearly defines the difference between actual care and the recommended course of action for a particular process. The reports should enable comparison of actual care with recommended care over time. The difference or discrepancy between the recommended course of action and actual care can be defined as a process variance. Variance from recommended care does not necessarily imply poor clinical practice, because clinical judgment should supersede recommended course of action.

Because such variance is expected, a reasonable, predetermined threshold of accepted variance should be considered for all processes. If this predetermined threshold is exceeded, the variance is evaluated to decide whether it clinically was justified or unjustified.

Variance from recommended care

The evaluation of variance can be simplified by analyzing variance as it relates to the healthcare worker, the system, or the patient. A healthcare-worker variance occurs when a caregiver does not provide the recommended action (eg, a physician who prescribes an antibiotic that it is not recommended in national guidelines). A system variance occurs when a recommended course of action is not performed because of a problem with the institution or healthcare system (eg, lack of an isolation bed at the time of admission of

a patient with CAP and risk factors for TB). A patient variance occurs when a recommended course of action is not performed as a direct result of something the patient did or did not do (eg, refusal of hospitalization).

Interventions for process improvement

If clinically unjustified variance is identified for a process of care, local actions should be implemented to decrease variance. When a poor process of care is related to a system failure, appropriate structural and organizational conditions should be created to improve the process. When a poor process of care is related to poor practice, local healthcare practices should be changed. The most common techniques for changing practice are education, reminders of a recommended course of action in the medical record or hospital information system, and healthcare-worker feedback on performance. If interventions are successful, the process of care will be improved, and local variance will be minimized or eliminated.

Summary

Clinical and economic outcomes in hospitalized patients with CAP directly are related to the way that certain processes of care are executed at the local-hospital level. For each process of care, a clear and evidence-based recommended course of action should be stated. Having an unambiguous action plan helps to develop process-of-care indicators and to educate healthcare workers. Improving processes of care is a secure way to improve outcomes in hospitalized patients with CAP.

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