Characterizing and developing strategies for the treatment of community-acquired pneumonia at a community hospital

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MC Fok, Z Kanji, R Mainra, M Boldt. Characterizing and developing strategies for the treatment of community-acquired pneumonia at a community hospital. Can Respir J 2002;9(4):247-252.

BACKGROUND: Patients admitted to Lions Gate Hospital, North Vancouver, British Columbia, with a primary diagnosis of community-acquired pneumonia (CAP) have a mean length of stay (LOS) of 9.1 days compared with 7.9 days for peer group hospitals. This difference of 1.2 days results in an annual potential savings of 406 bed days and warranted an investigation into the management of CAP.

OBJECTIVE: To characterize and provide recommendations for the management of CAP.

METHODS: A retrospective chart review of patients admitted with a primary diagnosis of CAP between May 1, 2000 and August 31, 2000.

RESULTS: Fifty-one patients were included in the study, with a mean LOS of 9.9 days and a median LOS of five days. Based on pneumonia severity index scores calculated for each patient, eight patients (16%) were admitted inappropriately. Initial empirical antibiotic choices were consistent with the Canadian CAP guidelines in 27 patients (53%), with inconsistencies arising mainly because cephalosporin or azithromycin monotherapy regimens were prescribed. Step-down from intravenous to oral antibiotics occurred in approximately 20 patients (39%). An additional 12 patients (24%) could have undergone step-down, and step-down was not applicable in 19 patients (37%). The potential annual cost avoidance from implementing admission criteria based on a pneumonia severity index score, applying step-down criteria and promoting early discharge criteria was estimated to be $220,000.

CONCLUSIONS: Considerable variability exists in the treatment of CAP. A CAP preprinted order sheet was developed to address the issues identified in the present study and provide consistency in the management of CAP at Lions Gate Hospital.

Key Words: *Antibiotics; Community-acquired pneumonia; Guidelines; Management strategies; Pneumonia severity index*

Résumé à la page suivante

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Caractéristiques et élaboration d'une stratégie de traitement des pneumonies extra-hospitalières dans un hôpital communautaire

CONTEXTE : La durée de séjour (DS) moyenne des patients admis à l'hôpital Lions Gate, au nord de Vancouver, pour lesquels un diagnostic primaire de pneumonie extra-hospitalière (PEH) a été posé s'établit à 9,1 jours comparativement à 7,9 jours pour des hôpitaux recevant une patientèle semblable. La différence de 1,2 jour se traduirait par une économie potentielle annuelle de 397 jours-patient et a justifié une recherche sur le traitement des PEH.

OBJECTIF : Caractériser le traitement des PEH et formuler des recommandations à cet égard.

MÉTHODE : Étude rétrospective de dossiers de patients hospitalisés pour un diagnostic primaire de PEH entre le 1er mai et le 31 août 2000.

RÉSULTATS : Cinquante et un patients (DS moyenne : 9,9 jours; DS médiane : 5 jours) ont participé à l'étude. D'après les résultats de l'indice de gravité des pneumonies, huit patients (16 %) ont été hospitalisés à tort. Les choix initiaux empiriques d'antibiotiques respectaient les lignes de conduite canadiennes relatives au traitement des PEH chez 27 patients (53 %); les principaux écarts consistaient en la prescription de céphalosporine ou d'azythromycine en monothérapie. Il y a eu passage de l'administration des antibiotiques de la voie intraveineuse à la voie orale chez 20 patients (39 %); ce passage aurait pu se faire dans 12 autres cas (24 %) mais non dans les 19 cas (37 %) restants. On a évalué à 206 300 $ le coût annuel qui aurait pu être évité si l'admission avait reposé sur un indice de gravité des pneumonies, s'il y avait eu changement d'administration des antibiotiques et si les critères de congé précoce avaient été mis en œuvre.

CONCLUSION : Il existe des différences importantes de traitement des PEH. Une fiche d'ordonnance préimprimée a donc été conçue pour corriger les problèmes relevés dans la présente étude et assurer l'uniformité du traitement des PEH à l'hôpital Lions Gate.

Community-acquired pneumonia (CAP) is a disease with significant morbidity and mortality. Canadian statistics indicate that pneumonia and influenza are the sixth leading causes of death, while American data indicate that CAP is responsible for 500,000 hospitalizations, 45,000 deaths and US$9.7 billion in hospital costs each year (1,2). Age-adjusted mortality rates show this to be a growing trend (3).

In response to the implications of this disease and its economic burden on resources, Canadian and American CAP guidelines have been published to facilitate its efficient treatment (4-7). These guidelines provide a valuable resource for effective management of this disease and recommend an assessment of 30-day mortality risk using a pneumonia severity index (PSI) score, diagnostic tests to perform, and choices for empirical, targeted and step-down antibiotic therapy. By incorporating these guidelines into management strategies known as critical pathways, several studies have demonstrated a reduction in institutional resources without compromising outcomes in terms of mortality or patient well-being (8,9).

Lions Gate Hospital (LGH) is a community hospital with 260 acute and 325 extended care beds. Data from program management reports indicated that for the period of April 1, 1998 to March 31, 1999, there were 338 patients admitted to the acute care wards with a primary diagnosis of simple pneumonia and pleurisy. While their average length of stay (LOS) was 9.1 days, the average LOS at peer group hospitals (those hospitals with a similar bed capacity to LGH) was 7.9 days. This increase in LOS by 1.2 days amounts to an annual potential savings of 406 bed days. Furthermore, no hospital-based treatment protocols are available to assist physicians with the decision-making process. The objective of the present study was to assess the management of CAP at LGH and provide recommendations for improved management of the disease.

PATIENTS AND METHODS

A retrospective chart review of patients admitted between May 1, 2000 and August 31, 2000 was conducted using a standardized data collection form. The patients included were 18 years or older and had a primary admitting diagnosis of CAP, defined as an acute infiltrate on chest radiograph suggestive of pneumonia, plus the presence of at least two of the following symptoms of acute infection: fever or hypothermia, rigours, sweats, new cough with or without sputum production, change in colour of respiratory secretions, chest discomfort, dyspnea or ausculatory findings consistent with pneumonia (5). Patients were excluded if they were hospitalized in the 14 days before the onset of symptoms, if they resided in a long term care facility before admission or if they had an immune deficiency (ie, having a history or presence of infection with the human immunodeficiency virus, taking more than 10 mg/day of prednisone or other immunosuppressive agents, receiving active treatment for cancer, or having history of organ transplantation, active tuberculosis or cystic fibrosis). A PSI score based on the available laboratory data and physical findings on admission was calculated for each included patient. Data collected included the decision to hospitalize based on the calculated PSI score; whether guideline-recommended diagnostic tests (chest x-ray, sputum and blood cultures) were performed; antibiotic selection for pneumonia in terms of choice, route and cost; timing and appropriateness of step-down from intravenous to oral antibiotics; whether early discharge occurred; and LOS. To evaluate the timeliness and appropriateness of step-down and early discharge, step-down and early discharge criteria from the literature and Canadian CAP guidelines were used (Table 1).

RESULTS

Of the 93 charts reviewed, 51 patients met the inclusion criteria and 42 patients were excluded. Of the excluded patients, six (14%) were younger than 18 years old, seven (17%) did not meet the definition of CAP, 18 (43%) had a suspected nosocomial or long term care facility source for their infection, and 11 (26%) had an immune deficiency.

The average age of the patients was 75±15 years (mean ± SD), and there were more male than female patients

(69% versus 31%, respectively). The average LOS for these patients was 9.9 days, with a median of five days and a range of one to 85 days.

The frequency of performing guideline-recommended diagnostic procedures (chest radiograph, and blood and sputum cultures) within 24 h of admission and the breakdown of positive culture results are illustrated in Figure 1.

Patients had an average PSI score of 101±33 (mean ± SD), and these scores are categorized into their respective classes in Table 2. The PSI, which stratifies patients into five mortality risk categories ranging from low to high risk, recommends inpatient treatment for patients in classes IV and V (mortality risk 8.2% to 31.1%) and outpatient treatment for patients in classes I, II and III (mortality risk 0.1% to 2.8%); class III patients could possibly be admitted for a brief observation period (5). As demonstrated in Table 2, eight patients were admitted as class III patients with borderline scores, which may suggest appropriate admission. However, the other eight patients in classes I and II could likely have been treated on an outpatient basis without affecting their mortality from a CAP perspective. The five deaths that occurred in classes IV and V were attributed to pneumonia, while the death of one person from class IV was attributed to a myocardial infarction.

Empirical antibiotic choices were consistent with the Canadian CAP guidelines in 27 patients (53%). These consisted of at least a second-generation cephalosporin plus a macrolide (Figure 2). Therapy was inconsistent with the guidelines in 24 patients (47%), with the prescription of cephalosporin monotherapy, macrolide monotherapy and regimens for suspected aspiration (Figure 3).

TABLE 1
Criteria for step-down and early discharge of patients with community-acquired pneumonia

Step-down criteria
Intact gastrointestinal absorption
Improving symptoms (eg, cough, shortness of breath)
Absence of fever (≤38°C) for ≥8 h
Negative blood culture
White blood cell count normalizing
Early discharge criteria
Able to tolerate oral antibiotics
Stable comorbid conditions
No need for diagnostic workup
No social needs
Normal oxygenation (oxygen saturation >90% on room air)

Data from references 9 and 11

Twenty patients (39%) underwent step-down to oral antibiotics (Figure 4). Step-down could have occurred earlier in 11 of these patients according to the predetermined step-down criteria. An additional 12 patients (24%) met the criteria for step-down, but remained on intravenous antibiotics for the duration of their course. Step-down was not applicable in 19 patients (37%), with the reasons pro-

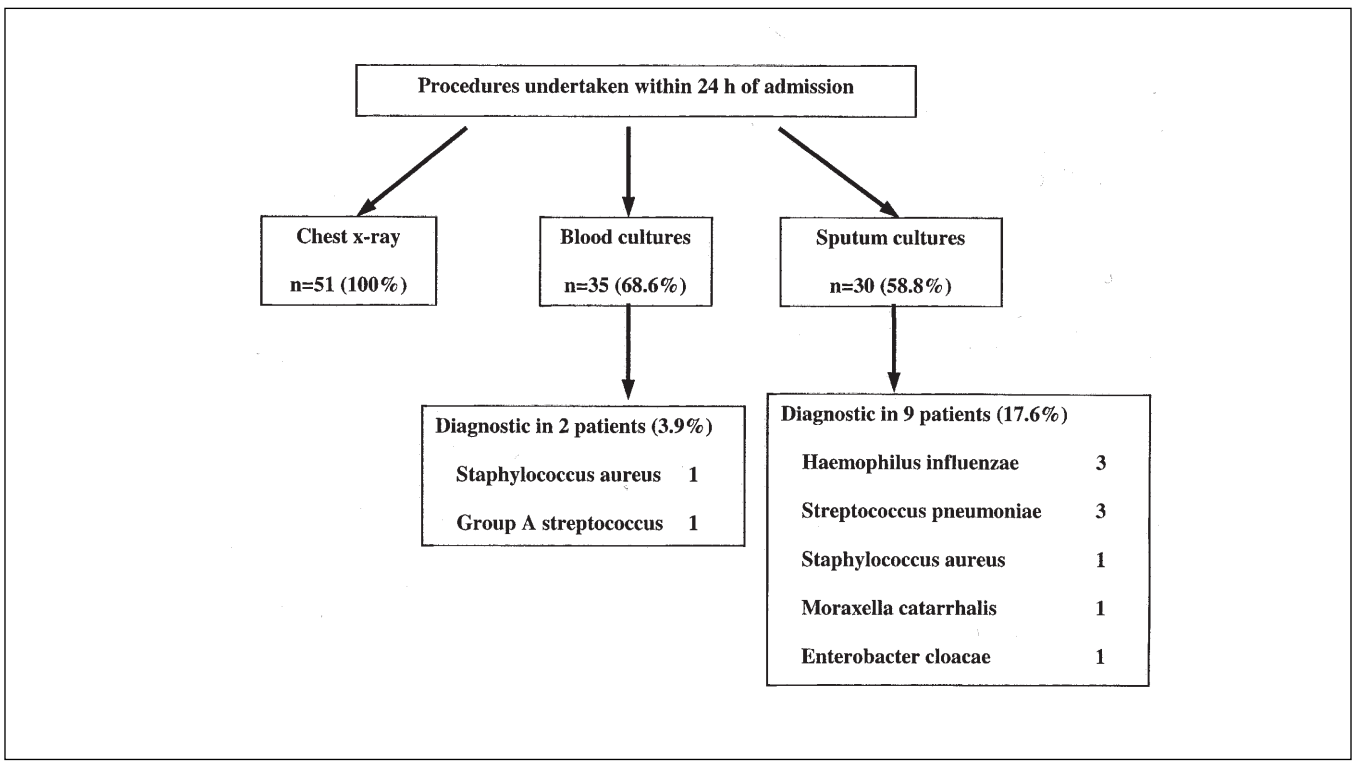

Figure 1) *The frequency of performing guideline-recommended diagnostic procedures (chest radiograph, and blood and sputum cultures) within 24 h of admission and the breakdown of positive culture results on 51 patients with community-acquired pneumonia at Lions Gate Hospital, North Vancouver, British Columbia*

TABLE 2
Pneumonia severity index (PSI) scores and classification of 51 patients with community-acquired pneumonia at Lions Gate Hospital, North Vancouver, British Columbia

PSI class	PSI score	Patients (n)	Deaths
I	0	2	0
II	≤70	6	0
III	71-90	8	0
IV	91-130	27	4
V	>130	8	2
Total		51	6

vided in Figure 4. By applying the predetermined early discharge criteria, 20 patients (39%) were discharged late, and the potential bed days saved from early discharge was 25 days or 1.25 bed days/patient.

DISCUSSION

The present study suggests that variability exists in the management of CAP at LGH. Areas for improvement were identified as the admission decision, which should use PSI scores as a tool to predict patients at high risk of mortality; antibiotic selection, which should have more consistency in guideline-recommended antibiotic regimens; and step-down, which should be timely and thus potentially lead to early discharge.

The mean LOS for the 51 patients included in the present study appeared to be consistent with program management reports (9.9 versus 9.1 days, respectively). However, the corresponding median LOS was calculated to be 5.0 days; the differences in the mean and the median were largely attributed to five patients who remained in the hospital for prolonged periods of time (15 to 85 days) for reasons other than pneumonia (for instance, patients may have been awaiting placement into an appropriate care facility or requiring further investigations for another disease process). Thus, the median LOS is more reflective of the actual LOS for our pneumonia patients. Because the data from program management reports did not contain information on the median LOS for pneumonia, no comparisons with peer group hospitals were possible. Nonetheless, the calculated median LOS of 5.0 days for the present 51 patients compares favourably with recent Canadian CAP LOS data in the literature, which report an overall median LOS of 7.0 days (interquartile range of 4.0 to 11.0 days) for both community and teaching hospitals (10).

The PSI score, which is a validated, prognostic indicator of 30-day mortality based on specific risk factors and laboratory values, has increasingly been used as a tool to facilitate the decision to admit patients (4,5). The mortality results from the present study appear to correlate with validated data in the literature, which report 30-day mortality rates of 8.2% to 9.3% for class IV patients and of 27.0% to 31.1% for class V patients. Closer examination of the PSI scores for the eight patients in classes I and II, who may have been admitted inappropriately, revealed that they had no significantly abnormal laboratory results nor any comorbid illnesses requiring a workup on presentation. Thus, by extrapolating the rate of possibly inappropriate admissions (eight of 51 patients) to the average number of CAP admissions per year (340 admissions/year based on in-house data), 53 admissions could potentially be prevented, with a savings of approximately 265 bed days annually (median LOS of 5.0 days/CAP admission). Although other patients do fill these beds, the amount that could have been reallocated based on these bed day savings is approximately $130,000 annually (cost savings/bed day equals $500/day).

The low yield of the blood and sputum cultures is surprising. The literature documents that blood cultures are positive in 8% to 10% of all admitted patients, while sputum cultures have ranged from 30% to 80% in their diagnostic usefulness (4). However, possible confounding factors such as the administration of antibiotics before admission or obtaining a specimen culture, not looking for

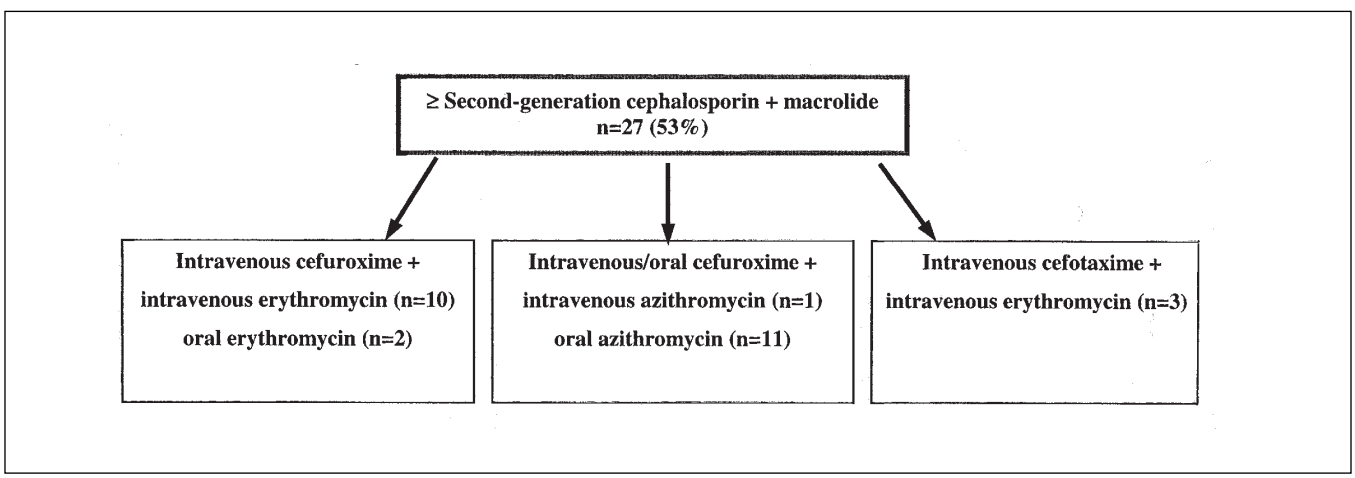

Figure 2) *Initial empirical antibiotic choices that were consistent with the Canadian community-acquired pnemonia guidelines in 51 patients with community-acquired pneumonia at Lions Gate Hospital, North Vancouver, British Columbia*

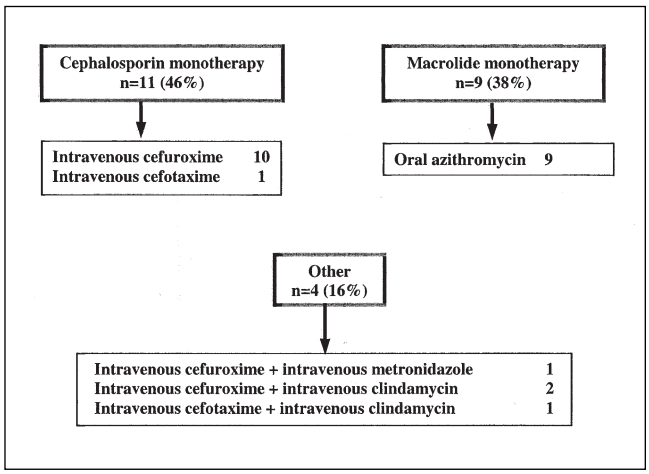

Figure 3) *Initial empirical antibiotic choices that were inconsistent with the Canadian community-acquired pnemonia guidelines in 51 patients with community-acquired pneumonia at Lions Gate Hospital, North Vancouver, British Columbia*

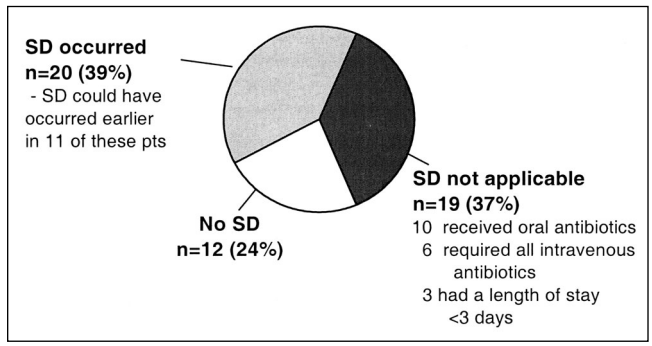

Figure 4) *Breakdown of step-down (SD) therapy for 51 patients with community-acquired pneumonia at Lions Gate Hospital, North Vancouver, British Columbia*

a specific pathogen or poor sampling techniques may have played a role in these results. The pathogens identified appear to be consistent with reports in the literature. However, one patient with asthma grew *Enterobacter cloacae*, and no atypical pathogens were identified, possibly due to a combination of their historically low incidence at LGH and the lack of specific tests ordered for organisms such as *Legionella pneumophilia*.

The rate of choosing initial antibiotic therapy at LGH that is consistent with the Canadian guidelines is lower than the estimate for Canadian hospitals reported in the literature (53% and 79.8%, respectively) (10). Furthermore, our data show that once patients reached the ward, therapy was altered in 15 patients (29%) (for example, combination therapy with a second-generation cephalosporin plus macrolide initiated in the emergency department was changed to macrolide monotherapy on the ward and vice-versa). The potential reasons for lower compliance with practice guidelines and discrepancies in what entailed adequate coverage between physicians in the present study are multifold. First, not all physicians may be aware of the latest practice guidelines, and a lack of familiarity may exist with those who are aware of them. Second, physicians may believe certain regimens are more suitable based on their success with the regimen, despite the practice guidelines. Finally, hospital trends for CAP pathogens and the prevalence of relatively uncommon pathogens may also play a role in determining what constitutes adequate therapy. Although 'respiratory' quinolones (eg, levofloxacin, moxifloxacin and gatifloxacin) were not on formulary at LGH at the time of this study, other guideline-recommended oral antibiotics were available for step-down. They included oral first- and second-generation cephalosporins (cephalexin, cefaclor, cefuroxime), as well as doxycycline, penicillins, erythromycin, azithromycin and clarithromycin. Four patients were prescribed empirical regimens with anaerobic coverage to cover for suspected aspiration (Figure 3). Because there was suspicion of aspiration, adding anaerobic coverage to the recommended antibiotic regimes for CAP seemed reasonable. However, because there was no atypical coverage with a macrolide, therapy was considered to be inconsistent with the guidelines.

Appropriately applying the predetermined step-down criteria could have decreased the duration of intravenous antibiotics by 2.5 days for 23 of 51 applicable patients, whose median duration of intravenous antibiotics was 4.3 days. The cost savings associated with this reduction of intravenous antibiotics using the equation:

(cost of intravenous antibiotics – cost of oral equivalent step-down antibiotic = cost savings)

amounted to a total savings of approximately $1,300 or $57/applicable patient in this study. The cost of intravenous antibiotics was based on actual acquisition cost and administration costs (preparation and administration of drug). By extrapolating these cost savings to the average number of CAP admissions per year (340 admissions/year), the projected annual cost savings was determined to be roughly $8,700. The number of patients meeting early discharge criteria was 20 of 51, with 25 potential bed days saved (1.25 bed days/patient). By applying these rates to the average number of CAP admissions per year (340 admissions/year based on in-house data), 167 bed days could potentially be saved annually with an estimated annual cost avoidance of $83,000 (cost savings/bed day equals $500/day).

Due to the retrospective nature of the present study, there are inherent limitations. Incomplete or inadequate documentation might have hindered the results. However, many of the end points used in this study were objective in nature and were always documented (for instance, LOS, antibiotic regimens selected, and criteria such as temperature and complete blood counts). Of the 19 parameters used for calculating the PSI, the only parameters that were not available for certain patients were arterial blood gases (ABGs) to determine arterial pH and/or the partial pressure of oxygen. Although the ABGs could have been abnormal and could have influenced the PSI scores from one class to

another, if there was no clinical suspicion of an abnormality and measurements of ABGs were not ordered, it is likely that these parameters would not have been abnormal. Our data reflect all of the laboratory information selected by physicians that was used to make an informed clinical assessment. No points were assigned for ABGs not measured on admission.

The strengths of this study included strict criteria for the definition of CAP, which incorporated patient symptoms and a positive chest radiograph suggestive of pneumonia; objective data parameters; and predetermined criteria for step-down and early discharge based on recent literature.

While the median LOS at LGH compared favourably with other Canadian hospitals, the findings of the present study suggest that improvements in areas such as the admission decision, diagnostic tests and the pharmacotherapeutic management of CAP can be made. This led to the recommendation that a CAP preprinted order sheet be created to provide consistency for the management of this disease. The preprinted order sheets incorporated a PSI scoring table as a resource to facilitate the admission decision, recommendations for diagnostic and laboratory tests, suggestions for empirical antibiotic choices based on the Canadian CAP guidelines, intravenous to oral antibiotic step-down criteria, suggestions for oral antibiotic regimens and early discharge criteria. Overall, the potential cost avoidance was estimated to be $220,000/year, which suggests a significant impact on treatment strategies. It is anticipated that this preprinted order sheet will improve the management of CAP at LGH without adversely affecting patient outcomes.

ACKNOWLEDGEMENTS: This project was conducted through the British Columbia Hospital Pharmacy Residency Program under no financial support or external affiliations.

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