Effects of a Preprinted Order on Management of Community-Acquired Pneumonia

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ABSTRACT

Background: A preprinted order was implemented in an effort to improve management of community-acquired pneumonia at an acute care hospital in an urban setting.

Objective: To evaluate use of the preprinted order and to compare management of community-acquired pneumonia before and after implementation of this tool.

Methods: A chart review was conducted for 3 groups of patients who had been admitted with community-acquired pneumonia: patients admitted after implementation of the preprinted order, divided into group A (preprinted order used in treatment plan) and group B (preprinted order not used), and historical controls (admitted before implementation of the preprinted order).

Results: Of the 103 patients with community-acquired pneumonia who were admitted after introduction of the preprinted order, 43 (42%) had preprinted orders in their charts. The rates of inappropriate admission, based on pneumonia severity index (either documented in the chart or determined on a post hoc basis for this study), were 8% (1/12) for group A patients with a documented pneumonia severity index, 35% (11/31) for group A patients without a documented pneumonia severity index, 33% (20/60) for group B patients, and 16% (8/51) for the historical controls. Both blood and sputum were cultured for 63% (27/43) of the patients in group A, 25% (15/60) of those in group B, and 47% (24/51) of the controls. Empiric antibiotic therapy was consistent with guidelines for 74% (32/43) of the patients in group A, 65% (39/60) of those in group B, and 53% (27/51) of the controls. Step-down therapy was initiated for 43% (13/30) of eligible patients in group A, for 27% (10/37) of those in group B, and for 62% (20/32) of controls. The mean length of stay was 6.9 days for group A patients, 7.4 days for group B patients, and 9.9 days for controls.

Conclusions: After introduction of a preprinted order for community-acquired pneumonia, the appropriateness of admission, rates of culture, and selection of empiric antibiotics consistent with guidelines increased, and length of stay decreased. The occurrence and timeliness of step-down was unaffected. As such, the introduction of the preprinted order increased compliance with published guidelines. More consistent use of the preprinted order and the pneumonia severity index might result in further improvements.

ABSTRACT

Historique : Un système d'ordonnances préimprimées a été mis en place dans le but d'améliorer le traitement des pneumonies extrahospitalières dans un centre hospitalier de soins de courte durée en milieu urbain.

Objectif : Évaluer l'emploi des ordonnances préimprimées et comparer le traitement des pneumonies extrahospitalières avant à après la mise en œuvre de ce système.

Méthodes : Une analyse des dossiers médicaux de 3 groupes de patients hospitalisés pour une pneumonie extrahospitalière a été effectuée : deux groupes formés des patients hospitalisés après la mise en œuvre des ordonnances préimprimées, le Groupe A chez qui les ordonnances préimprimées ont été utilisées dans leur plan de soins et le Groupe B chez qui les ordonnances préimprimées n'ont pas été utilisées; et un troisième, le groupe témoin historique, formé des patients hospitalisés avant la mise en œuvre des ordonnances préimprimées.

Résultats : Des 103 patients atteints de pneumonie extrahospitalière hospitalisés après la mise en œuvre des ordonnances préimprimées, 43 (42 %) avaient une telle ordonnance dans leur dossier. Les taux d'hospitalisation inappropriée, basée sur l'indice de gravité de la pneumonie (soit consigné au dossier médical, soit déterminé a posteriori pour cette étude), étaient de 8 % (1/12) pour les patients du Groupe A dont l'indice de gravité de la pneumonie était consigné, de 35 % (11/31) pour les patients du Groupe A sans indice de gravité de la pneumonie consigné, de 33 % (20/60) pour les patients du Groupe B, et de 16 % (8/51) pour les patients du groupe témoin. Une culture du sang et des crachats a été réalisée chez 63 % (27/43) des patients du Groupe A, chez 25 % (15/60) de ceux du Groupe B, et chez 47 % (24/51) des témoins. L'antibiothérapie empirique était conforme aux lignes directrices chez 74 % (32/43) des patients du Groupe A, chez 65 % (39/60) de ceux du Groupe B, et chez 53 % (27/51) des témoins. Un traitement dégressif a été amorcé chez 43 % (13/30) des patients admissibles du Groupe A, chez 27 % (10/37) des patients du Groupe B, et chez 62 % (20/32) des témoins. La durée moyenne des hospitalisations était de 6,9 jours chez les patients du Groupe A, de 7,4 jours chez ceux du Groupe B, et de 9,9 jours chez les témoins.

Conclusions : Après la mise en œuvre du système d'ordonnances préimprimées pour la prise en charge des pneumonies

Key words: preprinted order, community-acquired pneumonia, guidelines

extrahospitalières, on a observé une augmentation de la pertinence des hospitalisations, des taux de culture et du choix de l'antibiothérapie empirique conformément aux lignes directrices, et une diminution de la durée des hospitalisations. Le recours et l'opportunité du traitement dégressif n'ont pas été modifiés. Ainsi la mise en œuvre du système d'ordonnances préimprimées a amélioré le respect des lignes directrices publiées. Un emploi plus cohérent des ordonnances préimprimées et de l'indice de gravité de la pneumonie améliorerait peut-être davantage les résultats.

Mots clés : ordonnance préimprimée, pneumonie extrahospitalière, lignes directrices

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INTRODUCTION

In recognition of the significant morbidity and mortality caused by community-acquired pneumonia, various organizations have developed management guidelines to encourage efficient treatment of this disease.[1,2] The most recent guidelines were published jointly by the Infectious Diseases Society of America (IDSA) and the American Thoracic Society (ATS) in 2007.[3] Similar to previously published guidelines,[1,2] the 2007 guidelines[3] provide valuable tools and recommendations for management, including site-of-care decisions, diagnostic testing, and choices for empiric, targeted, and step-down antibiotic therapy, as well as recommendations for duration of therapy. By incorporating guidelines into management strategies such as use of a preprinted order or clinical pathway, the institutional resources required to provide high-quality care without compromising patient outcomes can be reduced.[4-6]

Lion's Gate Hospital is a 246-bed community acute care hospital in North Vancouver, British Columbia. In-house program management reports indicated that for the 338 patients admitted with a primary diagnosis of simple pneumonia and pleurisy (according to case mix group code 143) in the fiscal year April 1, 1998, to March 31, 1999, the average length of stay was 9.1 days, whereas the average length of stay at peer hospitals was 7.9 days.[7] This 1.2-day difference in length of stay per patient translated into 406 bed-days at an annual cost of $284 200. In the year 2000, the pharmacy department performed a study to characterize the management of community-acquired pneumonia at the hospital.[8] A preprinted order for community-acquired pneumonia was subsequently introduced (in July 2001) to improve the management of this disease. One side of the preprinted order lists the diagnostic tests to be performed, a selection of empiric antibiotics, and criteria for switching from IV to oral antibiotics (step-down therapy).[9-11] The other side provides a tool for assessing 30-day mortality risk, based on a pneumonia severity index, to help physicians triage patients for admission; criteria for early discharge are also listed.[2,10,12,13] The pneumonia severity index,[13] which stratifies patients into 5 categories ranging from low to high risk of mortality, recommends inpatient treatment for those in classes IV and V (mortality risk 8.2% to 31.1%) and outpatient treatment for those in classes I, II, and III (mortality risk 0.1% to 2.8%); patients in class III may be admitted for a brief observation period. The purpose of this retrospective study was to evaluate use of the preprinted order and to compare the management of community-acquired pneumonia after introduction of the preprinted order with management for a historical control group.

METHODS

The medical records of patients admitted between January 1 and December 31, 2002, with a primary diagnosis of community-acquired pneumonia (using case mix group code 143 for simple pneumonia and pleurisy) were reviewed. For patients included in the study, community-acquired pneumonia was defined as presence of new or progressive pulmonary infiltrates, as demonstrated by chest radiography, in combination with at least 2 of the following symptoms of acute bronchopulmonary infection: dyspnea, fever (body temperature of at least 37.8°C), hypothermia or rigours, increase in or new onset of cough, pleuritic chest pain, increase in sputum production, or purulent sputum.[1,2,14,15] Patients were excluded if they were under 18 years of age, if they had been transferred from another health

care institution, or if they were immunosuppressed.[14] Patients who had been transferred from another health care institution were categorized as having been discharged from an acute care hospital within 10 days of admission or as having been transferred from another acute care hospital or long-term care facility.[16,17] Immunosuppressed patients were defined as those receiving immunosuppressive therapy (including prednisone of at least 15 mg/day or an equivalent daily dose of another systemic corticosteroid for 14 days or more), any dose of azathioprine or cyclosporine, or active chemotherapy; those with known HIV seropositivity, progressive cancer, a diagnosis of cystic fibrosis or tuberculosis, or neutropenia (absolute neutrophil count less than 1×10^9/L); and those who had undergone organ transplantation.[14-16,18] Inclusion and exclusion criteria were the same as those used for the control group; data for this group were retrieved from the previously published report.[8]

When the preprinted order was implemented at the hospital, it was made available for use by all physicians on all wards, and a letter to physicians, indicating the availability and components of the order set, was issued. No prescriber education specifically related to the order set took place during the study period.

Patients admitted after implementation of the preprinted order whose medical records contained a copy of the order were designated as group A; those admitted after implementation but whose medical records did not contain a copy of the order were designated as group B. The following data were collected using a standardized form: appropriateness of admission to hospital, culture of sputum and blood, choice of empiric antibiotics for pneumonia, occurrence and timeliness of step-down from IV to oral antibiotics, occurrence and timeliness of early discharge, and length of stay. We used the criteria developed by Fine and others[13] as a tool for site-of-care decisions whereby patients with a pneumonia severity index of 91 or more would most likely benefit from admission to hospital, those with pneumonia severity index of 71 to 90 might be considered for a brief in-patient stay in hospital, and those with pneumonia severity index of 70 or less should be considered for treatment as outpatients. The pneumonia severity index was recorded as documented in the charts of patients for whom such scores had been calculated on admission; if the pneumonia severity index had not been documented, we calculated the index from information in the chart. To evaluate the timeliness and appropriateness of step-down and early discharge, criteria for these events from the literature, including Canadian guidelines for community-acquired pneumonia, were used.[1,2,8-12] Patients were considered eligible for step-down therapy when they met the following criteria: normally functioning gastrointestinal tract, improvement of symptoms (e.g., cough, shortness of breath), absence of fever (temperature no more than 38°C) for at least 8 h, negative results on blood culture, and normalization of white blood cell count.[2,12] Patients were considered eligible for early discharge when they met the following criteria: able to tolerate oral antibiotics, stability of comorbid conditions, no need for diagnostic work-up, no social needs, and normal oxygenation (oxygen saturation greater than 90% on room air).[2,12] Results for groups A and B were compared with those of the control group (patients from the original study[8] in year 2000, admitted before implementation of the preprinted order).

RESULTS

A total of 242 medical records were identified for review. Of these, 103 patients met the inclusion criteria. Of the 139 excluded patients, 50 (36%) did not meet the criteria for pneumonia, 26 (19%) were younger than 18 years of age, 19 (14%) had been transferred from another health care institution, and 44 (32%) were immunosuppressed. Of the 103 patients included in the study, 43 (42%) had a preprinted order for community-acquired pneumonia in the medical record (group A), and 60 (58%) did not (group B).

The mean age (± standard deviation) was 71 ± 19 years for patients in group A, 69 ± 20 years for patients in group B, and 75 ± 15 years for patients in the control group.

Overall, 12 (28%) of the 43 patients in group A, 20 (33%) of the 60 patients in group B, and 8 (16%) of the 51 control patients had a pneumonia severity index of 70 or less but were nonetheless admitted to hospital (Table 1). Of the 12 group A patients whose pneumonia severity index was documented by a physician at the time of admission, only 1 (8%) with a pneumonia severity index of 70 or less was admitted to hospital.

Guideline-recommended blood culture was performed within 24 h after admission for 84% (36/43) of the patients in group A and 60% (36/60) of the patients in group B; guideline-recommended sputum culture was performed within 24 h after admission for 65% (28/43) of the patients in group A and 32% (19/60) of those in group B. In the historical control group, blood culture was performed for 69% (35/51) of the patients and sputum culture for 59% (30/51). Both blood and sputum were cultured for 63% (27/43) of the patients in group A, 25% (15/60) of those in group B,

Table 1. Pneumonia Severity Index (PSI) for Patients with Community-Acquired Pneumonia

PSI Class*	No. (%) of Patients			
	Group A (*n* = 43)			
	PSI Documented† (*n* = 12)	PSI Not Documented (*n* = 31)	Group B (*n* = 60)	Control (*n* = 51)
Class I (0)	0 (0)	0 (0)	0 (0)	2 (4)
Class II (1–70)	1 (8)	11 (35)	20 (33)	6 (12)
Class III (71–90)	4 (33)	6 (19)	6 (10)	8 (16)
Class IV (91–130)	6 (50)	12 (39)	30 (50)	27 (53)
Class V (> 130)	1 (8)	2 (6)	4 (7)	8 (16)

*For patients for whom pneumonia severity index was not documented in the chart, the index was calculated from other information recorded in the chart.
†Refers to documentation of the pneumonia severity index in the patient's chart at the time of admission.

and 47% (24/51) of the controls. Among the 11 positive blood culture results, *Streptococcus pneumoniae* was the pathogen most commonly identified (8 [73%]); among the 11 positive sputum culture results, *S. pneumoniae* (5 [45%]) and *Hemophilus influenzae* (3 [27%]) were the pathogens most commonly identified.

Empiric antibiotic choices were consistent with the Canadian guidelines[1] for 32 (74%) of the 43 patients in group A, 39 (65%) of the 60 patients in group B, and 27 (53%) of the 51 patients in the control group. Appropriate choices consisted of (1) a second- or third-generation cephalosporin plus a macrolide or (2) a respiratory fluoroquinolone. Therapies inconsistent with the guidelines included cephalosporin monotherapy, macrolide monotherapy, and regimens for suspected aspiration.

Of the patients eligible for step-down therapy, 43% (13/30) in group A, 27% (10/37) in group B, and 62% (20/32) in the control group underwent step-down to oral antibiotics; among the patients who actually received step-down therapy, this could have occurred earlier for 54% (7/13) in group A, 30% (3/10) in group B, and 55% (11/20) in the control group.

By applying the predetermined early discharge criteria, we found that 57% (17/30) of the eligible patients in group A, 62% (23/37) of the eligible patients in group B, and 61% (31/51) of the eligible patients in the control group were discharged in a timely manner. The potential number of bed-days that could have been saved through early discharge (i.e., for patients who could have been discharged early but were not) was 3.4 per group A patient, 2.7 per group B patient, and 1.3 per control group patient.

The mean length of stay was 6.9 days for group A patients, 7.4 days for group B patients, and 9.9 days for control patients. The mean length of stay for groups A and B combined (i.e., after implementation of the preprinted order) was 7.1 days.

DISCUSSION

The present study suggests that, since the introduction of a preprinted order, management of community-acquired pneumonia in this community acute care hospital has become more consistent with guidelines in several respects. The use of historical controls for comparison has limitations, as there may have been other changes in practice over the 2-year period between data collection for the control patients (in 2000) and the post-implementation study (in 2002). However, the use of a historical group was probably valid for this study, because the same inclusion and exclusion criteria were applied, and the mean age of patients was similar.

The sizeable number of patients who were excluded was a result of following a strict definition of community-acquired pneumonia, as outlined in the Methods section. Immunocompromised patients and patients under 18 years of age were excluded because the management guidelines are not targeted to these populations.

After implementation of the preprinted order for community-acquired pneumonia, the form was not used for all patients, nor was the pneumonia severity index (included in the preprinted order) documented for all patients. The reasons are unknown but may include lack of awareness of the preprinted order during 2002, when the form was still relatively new and was not supported by ongoing education, or lack of documentation of the pneumonia severity index if a tool other than the preprinted order (e.g., an electronic tool) was used to calculate the index.

The pneumonia severity index is a validated, prognostic indicator of 30-day mortality based on specific risk factors and laboratory values.[13] Although the index is intended to predict mortality for patients with community-acquired pneumonia, its use has been

extrapolated to guide the admission process. Other factors may also guide admission, including the need for IV medications and lack of availability of outpatient resources. We did not try to determine factors that might have influenced the decision to admit patients to hospital. As stated in the preprinted order, the scoring system for the pneumonia severity index is to be used as a guideline and does not supersede sound clinical judgement.

Among patients for whom the pneumonia severity index was documented by the physician at the time of admission, use of the index appeared to minimize admissions of patients with scores of 70 or less. The estimated annual number of admissions that could have been prevented by using the pneumonia severity index was 85, according to the following equation: rate of inappropriate admission x average number of admissions for community-acquired pneumonia per year (where the overall rate of admission of patients in groups A and B with scores less than 70 was 31% and the mean annual number of admissions was 275, according to in-house data). Given the mean length of stay (after implementation of the preprinted order) of 7.1 days, this translates into a potential saving of 603 bed-days annually. Thus, the potential annual cost avoidance, given the $700 average daily cost of treating community-acquired pneumonia at Lion's Gate Hospital in 2001, was about $422 000. Although this number may not be entirely accurate because of the limited sample studied, it suggests the potential for significant cost savings with consistent use of the pneumonia severity index.

When it was used, the preprinted order proved a useful reminder to perform blood and sputum culture on admission, as recommended by the 2000 Canadian guidelines for management of community-acquired pneumonia.[1] The IDSA/ATS guidelines published in 2007 list a variety of clinical indications (e.g., admission to the intensive care unit, failure of outpatient antibiotic therapy, leukopenia, active alcohol abuse) for which more extensive diagnostic testing (i.e., beyond chest radiography or other imaging technique), including blood and sputum culture, should be performed; however, the guidelines suggest that these forms of testing are optional for patients who do not have these conditions.[3] For reasons of simplicity, it is likely that routine ordering of blood and sputum culture will continue to be adopted when management strategies such as preprinted orders or clinical pathways are implemented.

The higher rate of appropriate initial antibiotic therapy (i.e., consistent with guidelines) among patients with a preprinted order in their record suggests that the preprinted order can help physicians in their selection of empiric antibiotics. Possible reasons for the increase in appropriate prescribing for patients without a preprinted order, relative to the historical controls, include the addition of a respiratory fluoroquinolone to the formulary after the initial study and increased familiarity with the guidelines since their publication. Antibiotic selections that were inconsistent with the guidelines consisted mainly of macrolide monotherapy and cephalosporin monotherapy. Because of physicians' requests, these choices were available on the initial version of the preprinted order, even though they are not recommended in the guidelines. In an attempt to increase antibiotic prescribing consistent with the 2000 Canadian guidelines, these monotherapy options have now been removed from the preprinted order. Recommendations for empiric antibiotic therapy in the recent IDSA/ATS guidelines[3] have not changed substantially from those in previous guidelines.

Because information about step-down therapy and early discharge was presented as suggestions on the preprinted order, not as mandated requirements, it is unsurprising that use of the preprinted order had little effect on these 2 aspects of management. Furthermore, the suggestion for step-down therapy and the definition of early discharge appearing on the preprinted order are presented to physicians when the patient is being admitted to hospital, a point of care when neither option is relevant. It is unclear why the proportion of patients receiving step-down therapy was higher in the control group than in groups A and B. The community-acquired pneumonia timeline, a tool that directs follow-up management of this condition at specified intervals during the hospital stay, requires documentation of the route of administration by day 3, which may trigger step-down therapy. The timeline also suggests when discharge planning should take place, which may be a trigger for early discharge. The timeline was instituted at the same time as the preprinted order, and although its use and impact have not been assessed, it may have influenced step-down therapy and early discharge during the study period. More education may be required to increase physician awareness of the need to assess patients for step-down therapy and early discharge. The 2007 IDSA/ATS guidelines[3] follow the same principles as the 2000 Canadian guidelines[1] (which were used in this study) for switching therapy from IV to oral therapy and for discharging patients.

The mean length of stay was shorter after introduction of the preprinted order. As noted above, a community-acquired pneumonia timeline, with intended

length of stay of 5 days, was instituted concurrently with the preprinted order; however, its use has not been assessed, and the relative merits of the preprinted order and the timeline cannot be differentiated.

Because of the retrospective nature of the present study, incomplete or inadequate documentation and the small sample size might have had an impact on the results. We did not compare patient characteristics between the groups, and differences might have existed. A statistical analysis was not performed because this was an observational study using a historical control group, with no primary hypothesis. The strengths of the study include the use of a formal definition of community-acquired pneumonia, objective end points, and predetermined criteria for step-down and early discharge based on the literature.

Implementation at the authors' institution of a preprinted order for the management of community-acquired pneumonia resulted in improvements in appropriateness of hospital admission, rates of blood and sputum culture, selection of empiric antibiotics consistent with the guidelines, and length of stay. However, the occurrence and timeliness of step-down therapy and early discharge remained unchanged. More consistent use of the preprinted order and the pneumonia severity index scoring system at this institution may result in further improvements. Other measures, including the community-acquired pneumonia timeline and pharmacist-initiated policies for step-down therapy, are being undertaken to increase the occurrence and timeliness of step-down and early discharge.

References

1. Mandell LA, Marrie TJ, Grossman RF, Chow AW, Hyland RH; Canadian Community-Acquired Pneumonia Working Group. Canadian guidelines for the initial management of community-acquired pneumonia: an evidence-based update by the Canadian Infectious Diseases Society and the Canadian Thoracic Society. *Clin Infect Dis* 2000;31(2):383-421.
2. Mandell LA, Bartlett JG, Dowell SF, File TM Jr, Musher DM, Whitney C; Infectious Diseases Society of America. Update of practice guidelines for the management of community-acquired pneumonia in immunocompetent adults. *Clin Infect Dis* 2003; 37(11):1405-1433.
3. Mandell LA, Wunderink RG, Anzueto A, Bartlett JG, Campbell GD, Dean NC, et al. Infectious Diseases Society of America/ American Thoracic Society consensus guidelines on the management of community-acquired pneumonia in adults. *Clin Infect Dis* 2007;44 Suppl 2:S27-S72.
4. Benenson R, Magalski A, Cavanaugh S, Williams E. Effects of a pneumonia clinical pathway on time to antibiotic treatment, length of stay, and mortality. *Acad Emerg Med* 1999;6(12):1243-1248.
5. Marrie TJ, Lau CY, Wheeler SL, Wong CJ, Vandervoort MK, Feagan BG. A controlled trial of a critical pathway for treatment of community-acquired pneumonia. CAPITAL Study Investigators. Community-Acquired Pneumonia Intervention Trial Assessing Levofloxacin. *JAMA* 2000;283(6):749-755.
6. Dean NC, Silver MP, Bateman KA, Jams B, Hadlock CJ, Hale D. Decreased mortality after implementation of a treatment guideline for community-acquired pneumonia. *Am J Med* 2001;110(6):451-457.
7. *Lion's Gate Hospital respirology report card April 1, 1998 to March 31, 1999*. North Vancouver (BC): Lion's Gate Hospital; 1999.
8. Fok MC, Kanji Z, Mainra R, Boldt M. Characterizing and developing strategies for the treatment of community-acquired pneumonia at a community hospital. *Can Respir J* 2002;9(4):247-252.
9. Ramirez JA, Vargas S, Ritter GW, Brier ME, Wright A, Smith S, et al. Early switch from intravenous to oral antibiotics and early hospital discharge: a prospective observational study of 200 consecutive patients with community-acquired pneumonia. *Arch Intern Med* 1999;159(20):2449-2454.
10. Cassiere HA, Fein AM. Duration and route of antibiotic therapy in community-acquired pneumonia: switch and step-down therapy. *Semin Respir Infect* 1998;13(1):36-42.
11. Rhew DC, Weingarten SR. Achieving a safe and early discharge for patients with community-acquired pneumonia. *Med Clin North Am* 2001;85(6):1427-1440.
12. Rhew DC, TU GS, Ofman J, Henning JM, Richards MS, Weingarten SR. Early switch and early discharge strategies in patients with community-acquired pneumonia: a meta-analysis. *Arch Intern Med* 2001;161(5):722-727.
13. Fine MJ, Auble TE, Yealy DM, Hanusa BH, Weissfeld LA, Singer DE, et al. A prediction rule to identify low-risk patients with community-acquired pneumonia. *N Engl J Med* 1997;336(4):243-250.
14. Fink MP, Snydman DR, Niederman MS, Leeper KV Jr, Johnson RH, Heard SO, et al. Treatment of severe pneumonia in hospitalized patients: results of a multicenter, randomized, double-blind trial comparing intravenous ciprofloxacin with imipenem–cilastatin. The Severe Pneumonia Study Group. *Antimicrob Agents Chemother* 1994;38(3):547-557.
15. García-Ordóñez MA, García-Jiménez JM, Páez F, Alvarez F, Poyato B, Franquelo M, et al. Clinical aspects and prognostic factors in elderly patients hospitalised for community-acquired pneumonia. *Eur J Clin Microbiol Infect Dis* 2001;20(1):14-19.
16. Dedier J, Singer DE, Chang Y, Moore M, Atlas SJ. Processes of care, illness severity, and outcomes in the management of community-acquired pneumonia at academic hospitals. *Arch Intern Med* 2001;161(17):2099-2104.
17. Laurichesse H, Sotto A, Bonnet E, Abraham B, Neau D, Badiaga S, et al; Infectio-Sud Study Group. Pre- and in-hospital management of community-acquired pneumonia in southern France, 1998–99. *Eur J Clin Microbiol Infect Dis* 2001;20(11):770-778.
18. *The United States pharmacopeia. Vol 1: Drug information for the health care professional*. 17th ed. Rockville (MD): United States Pharmacopeial Convention, Inc; 1997. p. 983.

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