Treatment Guideline for Nursing Home-Acquired Pneumonia Based on Community Practice

Bruce J. Naughton, MD*‡‖ and Joseph M. Mylotte, MD, CIC *†‡§¶

OBJECTIVES: To describe the findings of a retrospective study of the treatment of nursing home-acquired pneumonia (NHAP) in 11 nursing homes in one community and the development of a treatment guideline for NHAP using data from the retrospective study.

DESIGN: A retrospective chart review of 239 episodes of NHAP occurring between November 1, 1997, and April 30, 1998, was performed. Data regarding antibiotic treatment of NHAP were used to revise a treatment guideline developed by the authors. Further refinements of the guideline were made based on small group discussions with physicians and nurse practitioners caring for the study population.

SETTING: Residents with NHAP were identified among the populations of 11 nursing homes in the metropolitan Buffalo, New York area (Erie county). These 11 nursing homes had a total of 2375 beds, comprising nearly one-third of all nursing home beds in the county.

PARTICIPANTS: Nursing home residents with chest X-rays showing infiltrates and signs and symptoms of pneumonia.

MEASUREMENTS: Antibiotic treatment (drug used, route of administration, and duration of treatment), location of initial treatment (nursing home or hospital), and status (alive or dead) of each resident were recorded 30 days after diagnosis of NHAP.

RESULTS: Of the 239 episodes of NHAP, 171 (72%) were initially treated in nursing homes. Of these 171 patients, 105 (61%) were treated only with an oral regimen, whereas 66 (39%) were treated initially with an intramuscular antibiotic and subsequently with an oral regimen. There was no significant difference in 30-day mortality rates between those initially treated in nursing homes (22%) and those initially treated in hospitals (31%; $P = .15$) or between those initially treated with an oral regimen in nursing homes (21%) and those initially treated with an intramuscular antibiotic in nursing homes (25%; $P = .56$). There was no consistency in how physicians made the choice to use intramuscular antibiotics in nursing homes, and a logistic model for predicting

this approach could explain very little. The frequency of the prescription of various antibiotic agents in nursing homes and in hospitals was tabulated as well as the duration of treatment; specific attention was paid to the timing of the switch to an oral agent among episodes initially treated with a parenteral agent. These data were used in the guideline to make specific recommendations regarding which agent to prescribe, the duration of parenteral therapy, the timing of the switch to an oral regimen, and the duration of treatment. In the setting of informal small groups, the guideline was discussed with physicians who cared for residents with NHAP in the study nursing homes. Revisions made to the guideline were based on these discussions.

CONCLUSIONS: A treatment guideline for NHAP was developed primarily on the basis of the practices of geriatricians in one community. These treatment practices were similar to those reported in the literature in terms of the proportion of patients treated in nursing homes and the antibiotics prescribed. The guideline also provided specific recommendations for timing of the switch to an oral agent after parenteral therapy and for duration of treatment. Studies are in progress to determine if use of this guideline will reduce some of the variation observed in the treatment of NHAP. J Am Geriatr Soc 48:82–88, 2000.

Key words: pneumonia; nursing home; guideline

Pneumonia is a leading cause of morbidity, hospitalization, and mortality among older people living in nursing homes.[1-3] The annual Medicare expenditures for acute hospitalization for pneumonia exceed $3.5 billion,[4] and as many as 28% of the Medicare beneficiaries admitted with pneumonia come from skilled nursing facilities (SNFs).[5] Once the diagnosis of NHAP is suspected or established and assuming that treatment is consistent with advance directives, there are

four major decisions to make in the treatment of this infection (Figure 1): (1) the location of treatment—nursing home or hospital; (2) the initial route—oral versus parenteral—of antibiotic treatment for those treated in nursing homes; (3) the timing of the switch to oral treatment in those given parenteral therapy in nursing homes or hospitals; and (4) the duration of treatment. An additional important decision not shown in Figure 1 is the choice of the antibiotic to administer.

From the Departments of *Medicine and †Microbiology and the Divisions of ‡Geriatrics/Gerontology and §Infectious Diseases, School of Medicine and Biomedical Sciences, State University of New York at Buffalo; the ‖Department of Medicine, Division of Geriatrics and Gerontology, Buffalo General Hospital and Deaconess Center; and the ¶Department of Medicine, Division of Infectious Diseases, Erie County Medical Center, Buffalo, New York.

Address correspondence and reprint requests to Joseph M. Mylotte, MD, Division of Infectious Diseases, Erie County Medical Center, 462 Grider Street, Buffalo, NY 14215.
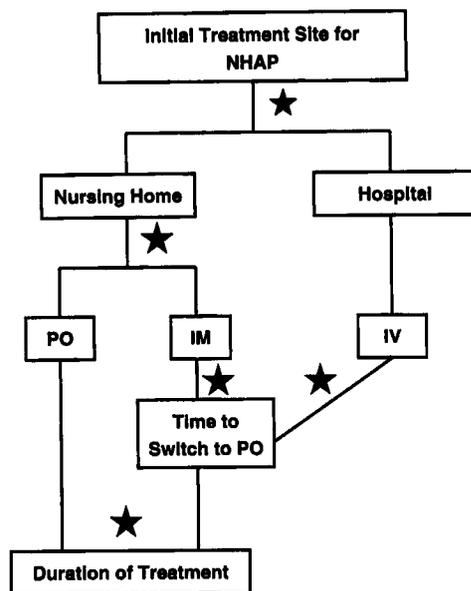
Figure 1. Decision tree for the treatment of nursing home-acquired pneumonia. Major decision points have been identified with stars.

Guidelines that address these important decisions for NHAP have not been published to our knowledge. The American Thoracic Society (ATS)[6] and Infectious Diseases Society of America (IDSA)[7] have recently published guidelines for the management of community-acquired pneumonia. However, these guidelines do not specifically address NHAP. Physicians may not readily extrapolate these guidelines to the nursing home population with pneumonia.

Guidelines developed for a number of conditions, including asthma, chest pain, cardiac arrest, and beta-blocker use, have not been consistently followed by practicing physicians.[8–12] The development of guidelines or modification of national guidelines by local primary physicians has been hypothesized as a means of improving guideline adherence and patient care.[13] We recently developed a guideline for the treatment of NHAP that was based primarily on the practices of geriatricians in the community. Information about the treatment of NHAP by practitioners in our community was obtained by retrospectively reviewing the medical records of residents in 11 nursing homes who had NHAP during the winter of 1997/1998. The analysis of medical record data, plus a series of small group sessions[14] with the physicians, nurse practitioners, and physician assistants responsible for treating NHAP in the study nursing homes, resulted in the final guideline. This report summarizes the findings of the analysis of the treatment of NHAP in 11 nursing homes in the Buffalo, New York area and describes the incorporation of these findings into a NHAP treatment guideline.

METHODS

Nursing Homes

Eleven SNFs in the metropolitan Buffalo, New York region (Erie county) participated in this study. Five of the participating SNFs were proprietary, four had religious affiliations, and one was a public facility. The 11 SNFs had a total of 2375 beds, comprising nearly one-third of all SNF beds within the county. Physicians and nurse practitioners from two private practice groups provided the majority of the medical care in the study facilities.

Study Design

Residents with NHAP in the 11 study nursing homes during the period from November 1, 1997, to April 30, 1998, were identified by review of infection control records at each facility. All residents 65 years and older with a diagnosis of pneumonia were eligible for inclusion in the study. Nursing home and hospital records were retrospectively reviewed to verify the diagnosis and to collect clinical information. Any episode of pneumonia less than 3 months after a preceding pneumonia episode was excluded from the analysis. Episodes with HIV-associated pneumonia were also excluded. Episodes of gastric content aspiration, however, could not be specifically excluded because of the retrospective design.

Data Collection

Research assistants blinded to the study's purpose recorded data on a form that was specifically designed for this study. The data collected included demographics, chest X-ray results, signs and symptoms of respiratory infection, initial location of treatment (nursing home or hospital), antibiotic treatment (drug used, route of administration, and duration of treatment), time of the switch to oral therapy, and status (alive or dead) 30 days after diagnosis. For residents who were hospitalized, hospital records were also reviewed and the same information that was obtained for those treated in nursing homes was abstracted for these patients. To maintain confidentiality, the residents' names or any other specific resident identifiers (e.g., medical record numbers) were not abstracted onto data collection forms.

Criteria for Diagnosis of NHAP

The criteria used to define NHAP were adapted from the Pneumonia PORT study.[15] NHAP was said to be present if a nursing home resident had a new radiologic pulmonary infiltrate not solely attributable to congestive heart failure, carcinoma, or pulmonary embolus plus at least one major or two minor additional criteria. Major criteria included cough, sputum production, or fever ($\geq 100.5°F$). Minor criteria included dyspnea, pleuritic chest pain, altered mental status, signs of pulmonary consolidation on physical examination, or a total leukocyte count of more than $12,000/mm^3$.

Guideline Development

Standard principles of guideline development were used to develop the NHAP treatment guideline.[16] An initial guideline was developed by the authors based on a review of the literature. The findings from the retrospective review of treatment for NHAP in 11 study SNFs were used to revise the guideline. The revised guideline was presented in a series of small group sessions held with physicians and nurse practitioners from both of the private practice groups that provided most of the medical care in the nursing homes. Each component of the guideline was presented for discussion at these meetings, and potential logistic problems were specifically discussed.[14] Only minor revisions were made to the guideline after the small group sessions. A final review of the guideline was conducted at a meeting involving participants from the small groups and other healthcare providers from the Buffalo metropolitan area.

Statistical Analysis

Pearson chi-square analysis was used to compare dichotomous variables, whereas the Student's t test was used to compare continuous variables. Multiple logistic regression analysis was used to define independent predictors of initial parenteral treatment in nursing homes. In this last analysis, only factors that would be readily observable at the bedside or by a nurse's chart review were evaluated. This approach was used to make the model as practical as possible for use in nursing homes. A P value of ≤ .05 was considered statistically significant for all analyses.

RESULTS

During the 6-month study period, 239 episodes of NHAP were identified among residents of the 11 study SNFs. The location and route of initial treatment of the 239 episodes of NHAP are outlined in Figure 2. Almost three-fourths of the 239 episodes were treated in nursing homes initially; of these episodes (n = 171), almost 40% were first treated with an intramuscular antibiotic. There was no significant difference in 30-day mortality rates between those initially treated in nursing homes (22%) and those initially treated in hospitals (31%; P = .15).

A major objective of the retrospective review of NHAP was to evaluate the treatment practices of practitioners in the community and to incorporate these practices into the treatment guideline. The treatment guideline that resulted from the analysis of the retrospective review of NHAP and from discussions with practitioners is shown in Figure 3. The decision to hospitalize a resident with suspected or proven NHAP is not addressed in this report.

A decision tree for the treatment of NHAP is shown in Figure 1 with the major decision points identified with stars. These decision points formed the major subheadings in the guideline. For episodes treated in nursing homes, there are three decision points. The first decision is the route of initial treatment, i.e., oral versus parenteral (intramuscular injection in all cases). Factors predictive of initial parenteral antibiotic treatment in nursing homes were sought so that they could be included in the treatment guideline. Factors assessed were those that would be readily apparent to the physician at the time of decision-making and included under-
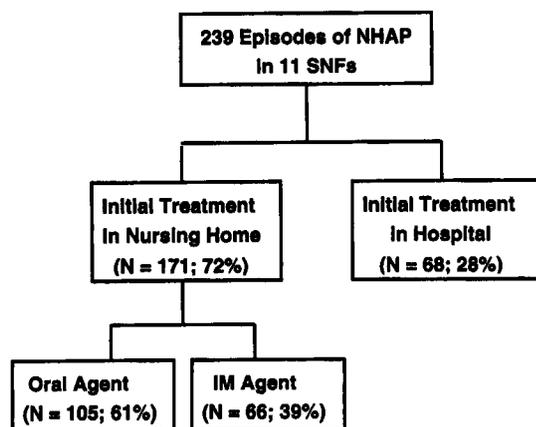

Figure 2. The location and route of treatment of 239 episodes of nursing home-acquired pneumonia identified in 11 nursing homes from November 1, 1997, to April 30, 1998.

lying illnesses, vital signs, presence of a feeding tube (as a measure of functional status), resuscitation status, and mental status. By univariate analysis, only very low (<96°F) and very high temperatures (>104 °F; P = .003) significantly predicted the use of parenteral treatment in nursing homes. By logistic regression, the temperature predictor was a significant independent predictor (P = .007; r^2 = 0.04) of parenteral therapy. However, the analog to explained-variance estimate of this model indicated that this predictor could explain very little. There was no significant difference in 30-day mortality rates between those initially treated with an oral agent (21%) and those initially treated with a parenteral agent (25%; P = .56) in nursing homes. There was also no significant difference in the rate of transfers to hospitals between those initially treated with an oral agent (16%) and those initially treated with an intramuscular agent (12%; P = .49). Based on these findings and on discussions with physicians, criteria were developed for deciding the initial route of antibiotic administration as shown in Figure 3. Ceftriaxone or cefotaxime intramuscularly was used in 56 (86%) of 65 episodes initially treated by this route in the retrospective study of NHAP. Therefore, either agent is recommended in the guideline if the intramuscular route is chosen as the initial route of treatment in nursing homes.

Because of the wide variation in oral agents prescribed by physicians in the retrospective study, the guideline allowed a broad choice of oral agents to prescribe at the initial treatment or at the time of the switch from a parenteral agent among patients in nursing homes (Table 1). For the 78 episodes treated with a single oral agent, the most common classes of agents prescribed were cephalosporin (36% of episodes), quinolone (21%), aminopenicillins (15%), and macrolide (13%). These classes of agents were also commonly prescribed when a switch was made from intramuscular treatment to an oral agent (data not shown).

The duration of treatment of NHAP by location of initial treatment is shown in Table 2. Only episodes in which residents survived more than 14 days after the onset of NHAP were included in this analysis. These data were analyzed to determine the timing of the switch to an oral regimen among those initially treated with an intramuscular antibiotic in nursing homes. The median duration of intramuscular therapy was 2 days, and the 75th percentile was 3 days. Thus, the guideline suggested that residents be evaluated for a switch to an oral regimen beginning on Day 2 with the goal of switching the majority by Day 4. In addition, the guideline also suggested assessing for clinical stability using modified criteria from studies of community-acquired pneumonia[17] as an aid to judging when to switch to an oral regimen (Figure 3).

For episodes of NHAP treated in nursing homes, there was no significant difference in the mean duration of therapy between those treated with only an oral agent (9.4 days) and those treated parenterally initially and by oral agent subsequently (9.0 days; P = .42). Data for the two groups were pooled, and the median duration of treatment was 9 days; by 10 days, treatment was completed for 75% of the episodes. Thus, the community standard was 7 to 10 days of treatment for most episodes of NHAP treated in nursing homes and was incorporated into the guideline.

Recommendations for treatment of patients with NHAP in hospitals are also listed in the guideline (Figure 3). Parenteral antibiotic therapy was administered in all but 3 of 68 episodes treated initially in hospitals. The most commonly

Treatment in the Nursing Home

1. <u>Route (PO or IM) of Initial Therapy</u>
   Treatment with a parenteral (IM) agent should be considered if:
   a. there is no response to an oral agent
   b. vital signs are abnormal
   c. resident has an acutely altered mental status and is unable to take oral medications (tube feeding not avaliable)

2. <u>Choice of Parenteral Agent:</u>
   Ceftriaxone 500-1000 mg IM QD or
   Cefotaxime 500 mg IM Q12H
   In the penicillin allergic person the type of hypersensitivity (rash, hives) should be considered in making a treatment decision.

3. <u>Timing of switch to an oral agent:</u>
   Residents given IM treatment should be switched to an oral agent when they achieve clinical stability. In most (75%) residents this will occur on day 3-5 of treatment. Clinical stability is defined as all of the following being present:
   a. improvement in signs and symptoms
   b. afebrile (<100.5 F) for $\geq$ 16 hours
   c. no acute cardiac or other life-threatening event in the first 3 days of treatment
   d. resident is able to take oral medication

4. <u>Oral Antibiotic Regimens:</u>
   Amoxicillin
   Amoxicillin/clavulanate
   2nd or 3rd generation oral cephalosporin
   In the penicillin allergic patient, Levofloxacin 500 mg PO QD can be prescribed.

5. <u>Duration of Therapy:</u> 7-10 days

Treatment in the Hospital

1. <u>Choice of Empiric Therapy:</u>
   Ceftriaxone 500-1000 mg IV QD
   Cefotaxime 500 mg IV Q8-12 H
   Ampicillin/sulbactam 1.5 gm IV Q6-8H
   Cefuroxime 750 mg IV Q8H
   In the penicillin allergic patient the type of hypersensitivity (rash, hives) should be considered in making a treatment decision. An alternative to consider is Levofloxacin 500 mg IV QD

   IV erythromycin should be avoided because of the adverse effects such as pain and phlebitis and increasing resistance of pneumococci to macrolides.

2. <u>Timing of switch to an oral agent:</u>
   When the resident achieves clinical stability (day 4-6), they can be switched to an oral agent:
   Amoxicillin
   Amoxicillin/clavulanate
   2nd or 3rd generation oral cephalosporin

   In the penicillin allergic resident, one of the Following agents can be used:
   Levofloxacin 500 mg PO QD
   Erythromycin

3. <u>Duration of Therapy:</u> 7-14 days

Figure 3. Guideline for the treatment of nursing home-acquired pneumonia. If renal insufficiency is present, dosage adjustments are necessary for agents which are excreted via the kidney. These agents include most penicillins, cephalosporins, and levofloxacin. Ceftriaxone does not require dosage adjustments for renal insufficiency until the creatinine clearance decreases to less than 20 cc per hour.

prescribed agents administered intravenously were ceftriaxone (34%) and ampicillin/sulbactam (29%); a quinolone was prescribed intravenously for only 4% of episodes. For the remaining one-third episodes, a variety of different agents was prescribed at low frequencies. Based on these findings, several parenteral agents are listed as a possible initial regimen. The approach to deciding when to switch to an oral agent was the same as for those treated in nursing homes with a parenteral agent: i.e., switch to an oral agent when clinical stability has been achieved. In the retrospective study, the median duration of intravenous therapy was 5 days, and the 75th percentile was 7 days. Based on these findings, the guideline suggested assessing for clinical stability beginning on Day 3 of intravenous therapy with the goal of switching

most residents to an oral agent by Day 6. Among the hospitalized residents, the median duration of therapy of those surviving more than 14 days was 10 days and the 75th percentile was 14 days (Table 2). Therefore, after discussing these findings with physicians, the authors included in the guideline a recommendation of therapy for 7 to 14 days.

The recommendations regarding treatment approaches in residents with an allergy to a beta-lactam underwent revision after the small group discussions. Before these discussions, the guideline recommended that a cephalosporin (oral or parenteral) not be used in residents with a history of penicillin allergy. However, during review of the guideline with physicians, concern was voiced about this recommendation because it was the frequent practice of some to adminis-

Table 1. Frequency of Prescription of Various Agents for 78 Episodes of Nursing Home-Acquired Pneumonia Treated Only with an Oral Agent in the Nursing Home

Agent	Total Overall*	As Single Agent
Macrolide		
Erythromycin	12	4
Clarithromycin	10	3
Azithromycin	3	3
Aminopenicillins		
Amoxicillin	6	3
Amoxicillin/clavulanate	15	9
Cephalosporin		
Cephalexin	21	14
Cefuroxime axetil	13	8
Cefaclor	7	6
Quinolone		
Ciprofloxacin	19	15
Levofloxacin	2	1
Other		
Trimethoprim/sulfa	13	8
Doxycycline	3	3
Clindamycin	1	1

* The total number of oral agents prescribed was greater than the number of episodes of pneumonia treated, because some episodes were treated with more than one agent either simultaneously or sequentially.

Table 2. Duration of Treatment of Nursing Home-Acquired Pneumonia by Location of Treatment*

Location of Treatment	No. of Episodes	Mean ± SD Duration (days)	Median Duration (days)	Range (days)
Nursing home				
Oral Rx only	78	9.4 ± 2.7	10	5–17
IM 1st/oral				
IM	45	2.8 ± 2.3	2	1–10
Oral	44	7.4 ± 2.7	7	4–16
Total	48	9.0 ± 3.0	8	4–21
Hospital				
IV	51	5.7 ± 3.4	5	1–18
IM	12	3.3 ± 2.3	3	1–8
Oral	43	7.3 ± 3.6	7	1–16
Total	54	11.6 ± 5.1	10	4–28

Rx = treatment, IM = intramuscular, IV = intravenous, SD = standard deviation.

* Residents who died within 14 days of onset of treatment were excluded for the purposes of calculating duration of treatment.

ter a cephalosporin in residents with a history of penicillin allergy. Based on these discussions, the guideline was revised so that it would not contraindicate the use of a cephalosporin in residents with penicillin allergy.

It should be noted that the guideline does not recommend the use of a macrolide or trimethoprim/sulfamethoxazole in those with penicillin allergy because of increasing resistance of Streptococcus pneumoniae in the community to these agents, especially to trimethoprim/sulfa.[18] In addition, for those residents hospitalized for treatment of NHAP, the guideline specifically suggests not using intravenous erythro-

mycin because of the high rate of adverse effects and the concern regarding resistance among pneumococci.

DISCUSSION

There is increasing evidence that most nursing home residents with pneumonia can be treated successfully with an oral agent in nursing homes.[19–22] A recent study has demonstrated that even the most severely ill residents with pneumonia can be treated with intravenous antibiotics in nursing homes with no significant difference in 30-day mortality rates compared with those with the same severity of NHAP treated in hospitals.[23] In addition, short-term outcomes of treatment of NHAP are significantly better among those treated in nursing homes compared with those hospitalized.[24,25] Nevertheless, variations in management of NHAP occur, and there has been little attempt to standardize the treatment of this infection.

The guideline for treatment of NHAP described in this report was developed in response to variations in the management of this infection observed by the authors and to the lack of published guidelines dealing specifically with this infection. The ATS[6] and the IDSA[7] guidelines for the management of adults with community-acquired pneumonia do not specifically address NHAP as a separate entity. The ATS guideline specifically states that NHAP was "not categorized separately because of lack of appropriate studies." It was the bias of the ATS panel of experts that "location of residence was less important than the presence of coexisting disease and age" in determining initial treatment of pneumonia. Zimmer and Hall,[25] however, have suggested that NHAP deserves to be considered as a separate entity when it comes to therapeutic decisions, in part because of the negative impact on functional status and mortality rates among those with this infection who are treated in hospitals.[24] Recently, in a review of NHAP, Muder[26] provided an algorithm for the management of residents suspected to have pneumonia. This algorithm did not specifically address the issues of switch therapy or the duration of therapy.

The guideline presented in this report was initially developed by two physicians after review of relevant literature. Community treatment practices of physicians were incorporated into the guideline based on a retrospective review of treatment of NHAP in a large sample of nursing home residents in one metropolitan area. The analysis of the treatment of NHAP by physicians in the community provided a basis for the specific antibiotic recommendations. In addition, the findings of the retrospective study were used to make specific recommendations regarding the timing of the switch to an oral agent among those initially treated with a parenteral agent and regarding the duration of treatment. The incorporation of community treatment practices for NHAP into this guideline lends the guideline credibility among practicing physicians[13] and supports the validity of their treatment approaches for this infection.

Two findings of the retrospective study of treatment of NHAP deserve emphasis. First, almost three-fourths of the residents with NHAP were initially treated in nursing homes. In published studies of NHAP,[19–22,27–30] 49% to 91% of episodes were treated in nursing homes. This wide variation is unexplained but is probably caused by uncertainties about the severity of the pneumonia, lack of physician examination at the time of the onset of pneumonia, and variations in study design (studies from one facility versus multifacility studies).

Second, in the present study, a parenteral (intramuscular) antibiotic was prescribed initially for 39% of episodes of NHAP treated in nursing homes. There was no significant difference in 30-day mortality rates between nursing home patients initially treated with an oral regimen and those treated with an intramuscular agent. In recently published studies of NHAP,[20–22,28] parenteral antibiotics were prescribed for 16% to 44% of episodes treated in nursing homes. Two of these studies[20,28] found a significantly higher mortality rate associated with parenteral therapy in nursing homes. However, after controlling for functional status[28] and do not hospitalize orders,[20] no differences in mortality rates were noted between nursing home patients treated with parenteral therapy and those treated with an oral agent.

Because of the relatively frequent use of intramuscular antibiotic treatment in nursing homes, we sought factors predictive of using this approach initially for NHAP that could be included in the guideline. However, only a very low or very high temperature was found to be a significant independent predictor of intramuscular treatment. This predictor could explain very little, suggesting that other factors that were not documented in the record were involved in this decision. The inability to identify factors that influence the use of intramuscular antibiotic therapy for NHAP may explain the wide variation in use of this treatment mode in studies of NHAP. In the present study, there seemed to be no consistency among physicians in determining which residents with NHAP should be administered intramuscular antibiotic therapy. The reason for this discrepancy was not clarified by the small group discussions with physicians. The criteria for prescribing intramuscular antibiotic therapy in the guideline could promote a more consistent approach to choosing this route of therapy.

The guideline provided considerable latitude in choosing an oral regimen for either initial therapy of NHAP in nursing homes or as a switch therapy from a parenteral regimen. This approach was taken because many different oral agents were prescribed in the retrospective study. No study of NHAP to date has included a sample size large enough to validly determine the optimal oral agent(s) for treatment of this infection. The guideline did suggest which antibiotics not to use for the treatment of NHAP. For example, it was assumed that *Streptococcus pneumoniae* causes about 20% to 40% of all episodes of NHAP.[26] It has been documented that resistance to macrolides and trimethoprim/sulfa is increasing among pneumococci.[18] Therefore, these agents should be used cautiously, if at all, for the empiric treatment of NHAP. On the other hand, intravenous antibiotic therapy among hospitalized residents with NHAP had more consistent results. Usually a second or third generation cephalosporin or ampicillin/sulbactam was prescribed in hospitalized residents in the retrospective study. Several other studies[21,22,30] have also documented that these agents are most commonly prescribed for residents hospitalized for NHAP.

There are several important issues related to NHAP that have not been addressed by the treatment guideline described in this report. First, the guideline does not address the diagnostic work-up for NHAP. Although this is an important issue, it would require a large prospective study to define the appropriate diagnostic testing to identify pneumonia among residents with suspected infection. Nevertheless, if a nursing home resident is suspected to have pneumonia, we suggest that, in addition to a chest X-ray, one should obtain measurements of serum blood urea nitrogen (to determine hydration status), a complete blood count, and pulse oximetry (to assess oxygenation). Second, the guideline does not address the decision to hospitalize a nursing home resident with pneumonia. This decision may be influenced by several factors,[20] including nursing home policy, the advance directives of the resident, the level of nurse staffing in a particular home, the time of day when the physician is called about resident illness, cross-coverage by other physicians, and the nursing staff's ability to accurately assess the severity of illness at the bedside. Bedside measures of the severity of NHAP that can aid the physician in the decision to hospitalize patients need to be defined. Recently, a model was developed that provides some bedside predictors of mortality for nursing home residents with lower respiratory tract infection (with or without pneumonia).[30] It is not clear whether the findings of this study[30] apply to residents with NHAP. The pneumonia prognosis index has been validated in nursing home residents with NHAP, and it is an accurate measure of both 30-day mortality rates and the severity of illness related to this infection.[23] However, this index requires laboratory testing that is often not performed in nursing homes.

A third issue not addressed by the guideline is the timing of initial antibiotic treatment of NHAP. Meehan et al.[31] have found that prompt (within 8 hours of arrival in the emergency department) treatment of patients with community-acquired pneumonia admitted to hospitals significantly improved outcome. We did not collect data concerning the timing of the first dose of antibiotic treatment in the present study. To our knowledge, there are no data similar to those of Meehan et al.[31] that are specific to NHAP. The relevance of this study[31] to nursing home residents with pneumonia treated in nursing homes is uncertain. The duration of the illness before diagnosis (a factor not considered by Meehan et al.[31]) and the severity of the illness at the time of diagnosis need to be taken into account when evaluating the outcome of treatment of pneumonia.

Finally, the guideline does not address follow-up care in nursing homes. Data on physician or nurse practitioner follow-up after initiation of treatment in nursing homes were not collected in the present study. We believe that it is important to determine the community standard regarding such follow-up visits before including any recommendations about this issue in a NHAP treatment guideline. Regarding follow-up chest X-rays, these were also not a focus of the present study and were not included. However, based on discussions with data abstractors and on our own experience treating NHAP, follow-up X-rays are not routinely performed if a resident responds to treatment. It is not necessary, in our opinion, to document clearance of a pneumonic infiltrate if the resident becomes asymptomatic and returns to his or her prepneumonia status. Clearance of infiltrates may be delayed for several weeks in nursing home residents because of both older age and underlying lung disease.[32]

In summary, a treatment guideline for NHAP was developed based primarily on treatment practices among a group of geriatricians in one community. This guideline may have general applicability because the findings regarding antibiotics prescribed and outcome of treatment were similar to those of other published studies of NHAP. The fact that community treatment practices are the basis for the recommendations in the guideline may enhance the likelihood that it will be used by physicians in their everyday practices.[13] The next

step is to determine whether the guideline influences physicians' management of NHAP so that variations in outcome measures are reduced. To this end, the authors have initiated a randomized, controlled pilot study to determine if the education of SNF nursing staff, in conjunction with the education of physicians and nurse practitioners, in the use of the guideline will have an impact on such outcomes as the decision to use intramuscular antibiotic therapy, the timing of the switch to an oral agent, or the duration of treatment. Finally, we agree with Zimmer and Hall[25] that data are now available to support randomized, controlled trials to determine if most residents with NHAP can be effectively and safely treated in nursing homes as opposed to being hospitalized.

ADDENDUM

In the original manuscript, the guideline (Figure 3) recommended either levofloxacin or trovafloxacin as a potential alternative agent in the treatment of persons with penicillin allergy. However, after submission of the revised manuscript, the Food and Drug Administration released information about a possible link between trovafloxacin therapy and hepatotoxicity. Although the actual risk of hepatotoxicity related to trovafloxacin therapy is not known, the authors believe that it would be prudent not to prescribe trovafloxacin for the treatment of pneumonia in nursing home residents until more data are available about the incidence of this potentially severe adverse effect. Thus, trovafloxacin is not recommended as an alternative agent for those with penicillin allergy in the guideline as published.

ACKNOWLEDGMENTS

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