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Guidelines for the approach to nursing home-acquired pneumonia

‘Professional healthcare organizations involved with elders need to demand the inclusion of geriatric specialists in the panels developing such practice documents when the disease entity occurs in the elderly.’

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Nursing home-acquired pneumonia (NHAP) is the second most frequent infection occurring in this setting (urinary tract infections being the most frequent) and has the highest morbidity and mortality rates of all infections in this setting [1]. Healthcare-associated pneumonia (HCAP) is a relatively new concept in lower respiratory tract infections that is applicable across several healthcare settings [2]. This term applies to any patient fulfilling one or more of the following criteria: residence in an acute care hospital for 2 or more days within 90 days of the index infection; residence in a nursing home or other type of long-term care facility; receipt of intravenous antimicrobial therapy, chemotherapy, or wound care within the 30 days prior to the index infection; and previous attendance at a hospital or hemodialysis clinic [2].

In addition, selected nursing homes manage patients undergoing long-term ventilatory support and, thus, ventilator-associated pneumonia (VAP) guidelines will be of interest to practitioners in this specialty practice [2]. In this editorial, several guidelines for the management of community-acquired pneumonia (CAP) will be reviewed, with the intent to demonstrate to what degree their recommendations are applicable to residents of nursing homes. Based upon the results of this review, the limitations of using existing CAP guidelines as a basis for treating NHAP will be discussed followed by a practical, evidence-based approach to NHAP management in the facility setting.

Community-acquired pneumonia guidelines from the following jurisdictions contain no, or virtually no, material that is nursing home- or nursing home resident-specific: The Netherlands (2005) [3], Europe (2005) [4], Sweden (2005) [5], Saudi Arabia (2002) [6], Gulf (Middle East) (2007) [7], Japan (2006) [8], South Africa (2007) [9], Taiwan (2006) [10], Italy (1995) [11], South America (2002) [12] and the USA (2005 and 2007) [2,13]. Of interest, the 2007 Infectious Diseases Society of America (IDSA)/American Thoracic Society

(ATS) CAP guidelines [13] recommend that non-ambulatory nursing home residents with pneumonia be managed using the 2005 ATS/IDSA Healthcare-Associated Pneumonia guideline [2], which itself contains no nursing home- or nursing home resident-specific content. The 2007 IDSA/ATS CAP guidelines do not mention the management of ambulatory nursing home residents with pneumonia [13]. In addition, the IDSA/ATS committee membership was devoid of representation from experts in the field of nursing home-acquired infectious diseases [2,13]. All of the guidelines appeared to ignore the evidence base that exists for all facets of NHAP diagnosis and treatment (see below). One must acknowledge that nursing homes are not a component of the eldercare landscape in certain parts of the world and the absence of nursing home-specific data in guidelines from these areas makes perfect sense.

Of all reviewed CAP guidelines, only the 2000 Canadian Infectious Disease Society/Canadian Thoracic Society CAP guidelines have made a reasonable attempt to discuss NHAP [14]. These guidelines briefly discuss microbiology, prognostication and treatment of NHAP. Unfortunately, these guidelines have not been updated.

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Guidelines such as those reviewed above are reasonable for the management of nursing home residents admitted to hospital and, in the case of the 2005 ATS/IDSA VAP guidelines [2], are logical for residents undergoing long-term ventilatory support who frequently need, at least, a short hospital stay to manage VAP.

Adoption of the reviewed guidelines to the management of CAP in nursing home residents would be problematic for a number of reasons.

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Acquisition of lower respiratory tract secretions using invasive means in the usual facility setting is just not possible. As such, the clinician is forced to use empiric therapy for the entire therapy course. Therapeutic decisions have to be made solely on the basis of clinical response. Although most/all of the recommended assessments for therapeutic response are available in the nursing home setting, assessments are limited with respect to hemodynamic changes (i.e., limited to systemic blood pressure and postural responses) and organ function (i.e., limited to renal and liver function testing). Based on the recommended agents and the virtually universal recommendation to always initiate with intravenous (iv.) therapy, few nursing homes would be able to manage pneumonia within the facility using two-, three- or four-drug combination iv. regimens. Even facilities that are able to provide iv. therapies would be quickly overwhelmed, considering the prevalence of pneumonia in the nursing home setting. Without the availability of culture and sensitivity data, there would be no rational way to streamline therapy to fewer agents of narrower spectra and/or oral agents. As a result of these realities, virtually all nursing home residents would be forced into the hospital for diagnostic workup and receipt of at least initial empiric iv. therapy. The financial consequences of this approach would be staggering.

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Furthermore, these guidelines do not even mention the issue of site of treatment and selecting residents for outpatient (i.e., in-facility) versus inpatient (i.e., in-hospital) treatment. There is no discussion of any of the available algorithms that have been advanced to assist in this selection process. There is also no mention of mitigating factors, such as the refusal of hospitalization by the patient and/or his/her decision maker(s), which made be made for a wide variety of reasons (including orders to ‘do not hospitalize’). This latter situation forces in-facility management, which these guidelines do not even consider.

Another reason why in-facility treatment of NHAP is not considered in these guidelines is the emphasis on the use of two prognostication rules (that from the Pneumonia Outcomes

Research Trial [PORT] [15] and CURB-65 from the British Thoracic Society [16]). In the PORT ruleset, points for age alone will stratify the vast majority of nursing home residents into a risk class ‘mandating’ hospitalization. Nursing home residence (ten additional points) also prejudices risk class assignment [15]. In CURB-65 (and its modifications), all patients over 65 years of age receive one point and are stratified automatically into risk class II (1–2 points), which ‘mandates’ hospitalization [16]. A major shortcoming of both rulesets is the major role of age and the ability of age alone to overestimate true mortality risk. Age alone is not a reasonable argument for hospitalization in the absence of other severity criteria. Age should never be the sole criterion to hospitalize for the treatment of NHAP. A modified PORT ruleset may be more reasonable to use in this context [6]. In this ruleset, three questions are asked:

- Is the subject over 50 years old?
- Does (s)he suffer from one or more of the following: cancer, heart failure, stroke, liver disease or renal disease?
- Is the level of consciousness altered from baseline or does (s)he have one or more of the following unstable vital signs: heart rate over 125/min, respiratory rate over 30/min, systolic blood pressure below 90 mm Hg or temperature below 35°C or above 40°C?

Answering ‘No’ to all three questions stratifies the subject into risk group I (outpatient therapy). Answering ‘Yes’ to all three questions stratifies the subject into risk group III (hospitalization). Answering ‘Yes’ to one or two questions stratifies the subject into risk group II (close observation plus treatment or hospitalization for the initial 48 h). At least some nursing home residents could be treated in-facility using this ruleset.

Nursing home practitioners have long been aware that not all nursing home residents require hospitalization for the management of NHAP. Formal studies have indicated that 63–78% of residents can be safely managed in the nursing home setting [17–21]. In most studies, survival rates in the nursing home and hospital settings have been similar [17–20,22]. Even individuals in PORT class V who are very old and have multiple, stable chronic diseases can be managed successfully outside of the hospital [23]. Residents with low- and medium-mortality risks can be treated cost effectively in the nursing home setting [17,24]. Using a clinical pathway for in-facility treatment of NHAP based on use

of oral antimicrobials, availability of portable chest x-rays, oxygen saturation monitoring, rehydration and close monitoring, the clinical outcomes of those treated in nursing homes were comparable to, or superior to, those treated using usual approaches (including, frequently, hospitalization) [25].

“...the challenge is to incorporate prognostication rulesets into a tool that is able not only to predict death, but also to predict deterioration of functional status due to hospitalization.”

One study has even found that hospitalizing nursing home residents for initial treatment of NHAP may be deleterious. In the context of ‘mild’ pneumonia (defined as a respiratory rate below 40/min), a significantly greater proportion of survivors treated in the nursing home setting had either no change in functional status or were better than at baseline at the 60-day follow-up than those initially treated in the hospital setting (55 vs 39%; $p = 0.005$). In the context of ‘severe’ pneumonia (defined as a respiratory rate of at least 40/min), hospitalization only positively affected ‘immediate’ mortality. These authors concluded that the majority of nursing home residents had only ‘mild’ disease and that treatment in the facility setting was preferable [18].

The latter finding can be easily explained by the persistent deterioration in performance status that occurs subsequent to hospital admission. All nursing home residents admitted to hospital will experience functional loss, especially those who were functionally independent prior to hospitalization [16]. Another factor to be considered is that, independent of history of present illness and presumptive diagnosis, evaluation in an emergency department with subsequent admission to hospital may be overused among nursing home residents [26–31].

Hospitalization may also not be in the best interests of the nursing home resident and her/his family, especially in the context of advanced dementia [32,33]. Recent work has established that residents and families prefer NHAP treatment in the nursing home, where possible. Both parties feel that caring and personal attention are more easily accessible in the nursing home. In addition, family members want to be consulted/involved in the decisions surrounding whether or not to hospitalize their family member for NHAP treatment [34].

Before NHAP treatment can occur in the nursing home setting, one has to assure that such care is not beyond the means of the facility. Although the 2005 American College of Chest Physicians (ACCP) position statement on management of CAP in the home setting is not meant to be applied to nursing home residents (per ACCP), many facets of this document do reasonably apply to the nursing home care setting. For example, elements that must be assured prior to initiating treatment in the nursing home (just as in the home) include the abilities to provide antimicrobial therapy (starting within 8 h of presentation), oxygenation (with a goal of optimizing within 4–8 h of presentation), smoking cessation, hydration (starting within 4–8 h of presentation), nutrition, maintenance of functional capacity, treatment of ancillary symptoms (e.g., cough and pain), treatment of coexisting illnesses and follow-up by medical practitioner(s) [35].

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At present, the challenge is to incorporate prognostication rulesets into a tool that is able not only to predict death, but also to predict deterioration of functional status due to hospitalization. This tool also needs to incorporate the ability of the facility to provide quality NHAP care as well as advanced directives [16]. Such a tool would be useful in making the decision whether or not to hospitalize to treat NHAP.

A reasonable database exists upon which to provide recommendations for the practical management of NHAP. The first issue is how to identify residents who are highly likely to have pneumonia, using measures readily available in this setting. Results of recent research now enable the practitioner to calculate the probability of pneumonia in nursing home residents as a function of selected clinical signs/symptoms (e.g., altered mental status, wheezing, delirium and rales), vital sign results (e.g., respiratory rate, temperature and heart rate), and laboratory tests (e.g., white blood cell count), all of which are readily available and assessable in the facility setting [36]. Focusing on these parameters will help when considering a diagnosis of pneumonia in nursing home residents.

The next issue is to consider the site of treatment of NHAP. The liabilities of existing population prognostication rulesets have been discussed previously. The Missouri LRI Study identified patient characteristics predictive of 30-day mortality in 1044 nursing home residents with pneumonia. Overall, 30-day mortality was 14.7%. An eight-variable model was developed to predict 30-day mortality: blood urea nitrogen, white blood cell count, body mass index, heart rate, activities of daily living status, absolute lymphocyte count, gender and deterioration in mood in the previous 90 days. Mortality rates for residents having risk scores of 1–4 (low), 5–6 (relatively low), 7–8 (moderate), 9–10 (high) and 11–17 (very high) were 2.2, 6.2, 15.8, 35.9 and 60.0%, respectively [37]. Criteria supporting treatment of NHAP in the facility have been established [36]. These criteria were derived from a pooled analysis of the results of several trials evaluating factors associated with failure and success of in-facility NHAP treatment [19,20,38]. Criteria (associated with success) included a respiratory rate less than 30/min, oxygen saturation on room air of at least 92%, heart rate less than 90/min, temperature ranging from 36.5 to 38.1°C, systolic and diastolic blood pressures within 10 mm Hg of their usual values, no feeding tube being present, being conscious, severity of pneumonia score of two points or less (where respiratory rate above 30/min = 2 points; heart rate above 125/min, altered mental status and delirium = 1 point each) and the availability of adequate medical and nursing support [36].

The next issue is the decision of when to initiate antimicrobial therapy and which agent(s) to use in nursing home residents with pneumonia. A Canadian Consensus Conference of North American experts in the area of infectious diseases in the nursing home setting has developed recommendations for when to start empiric antimicrobial therapy in the nursing home resident suspected of having pneumonia [39]. If the resident is afebrile, has chronic obstructive pulmonary disease (COPD) and is over 65 years old, antimicrobial therapy should be initiated when a new onset or increased (from baseline) cough with purulent sputum has developed. The afebrile resident who does not have COPD should have therapy initiated only when a new onset cough with purulent sputum plus either a respiratory rate exceeding 25/min or delirium has developed. In the febrile resident (temperature >102°F), therapy should be started when the respiratory rate exceeds 25/min or a productive cough is present. If the temperature exceeds 100°F (or is 2.5°F or more above baseline) but is below 102°F, therapy should be started

when cough is present and at least one of the following has developed: heart rate greater than 100/min, rigors, respiratory rate exceeding 25/min, and delirium (latter defined as a disturbance of consciousness with a decreased ability to focus, shift or sustain attention; a change in cognition or development of a perceptual disturbance not accounted for by dementia; and development of symptoms has occurred over a short period of time and is characterized by a fluctuating course during the day).

“The choice of empiric antimicrobial therapy of nursing home residents with pneumonia must be made in the light of the resources available at the site of therapy delivery.”

The choice of empiric antimicrobial therapy of nursing home residents with pneumonia must be made in the light of the resources available at the site of therapy delivery. Suggested empiric therapies are specific to the site of therapy delivery [36]. Suggested regimens for in-facility therapy include intramuscular (im.)/iv. cefepime or ceftriaxone plus an oral macrolide (azithromycin or clarithromycin) or an oral respiratory fluoroquinolone (levofloxacin, moxifloxacin or gemifloxacin). In the hospital ward setting, suggested regimens include iv. cefepime or ceftazidime or piperacillin-tazobactam plus either an iv. respiratory fluoroquinolone (levofloxacin or moxifloxacin) or an iv. macrolide (azithromycin or erythromycin). In the intensive care unit setting, suggested regimens include iv. cefepime or piperacillin-tazobactam plus either an iv. fluoroquinolone (if *Pseudomonas aeruginosa* is suspected, use ciprofloxacin; if *Legionella* species are suspected, use a respiratory fluoroquinolone) or iv. aminoglycoside plus iv. vancomycin. The agents listed for hospital-based therapies are very similar to those from the 2007 IDSA/ATS CAP guidelines [13], but a distinction is made between general hospital ward and intensive care unit therapies as noted in previous CAP guidelines (i.e., one- or two-drug therapy vs three-drug therapy, respectively). The in-facility therapy recommendations pragmatically allow im. drug administration in patients who are less ill or in facilities where iv. therapy is unavailable or delayed. Oral therapy is also listed as acceptable. Regardless of the route of administration, initiating antimicrobial therapy within 8 h of the presentation of pneumonia improves the survival of elderly patients [40].

As with many other consensus conference papers, guidelines, and treatment algorithms for other disease states, existing CAP management guidelines do not provide practical recommendations tailored to nursing home residents. This has occurred despite a reasonable database and a cadre of experts in the field of NHAP. This paper has reviewed the limitations of these guidelines and has provided alternative evidence-based recommendations for the management of NHAP.

The only way to resolve the 'therapeutic orphan' status of nursing home residents in consensus documents, guidelines and treatment algorithms is for the geriatric healthcare practitioner population to be much more proactive and vocal in its advocacy of this patient population. We need to be vigilant for such documents as early in their development process as possible and provide input as individuals, whether solicited or not. Professional healthcare organizations involved with elders need to demand the

inclusion of geriatric specialists in the panels developing such practice documents when the disease entity occurs in the elderly. These organizations also need to provide meaningful input, when requested, despite the workload and rapid turnaround time that may be imposed. It's time for geriatric healthcare practitioners to get off the sidelines and become real players in the arena of guideline/algorithm development. Our clients deserve nothing less.

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Bibliography

Papers of special note have been highlighted as:

• of interest

•• of considerable interest

- Guay DRP: Infectious diseases. In: *Therapeutics in the Elderly*. Delafuente JC, Stewart RB (Eds). Harvey Whitney Books, Cincinnati, OH, USA 569–598 (2000).
- Anonymous: Guidelines for the management of adults with hospital-acquired, ventilator-associated, and healthcare-associated pneumonia. *Am. J. Respir. Crit. Care Med.* 171(4), 388–416 (2005).
- **Provides details on managing ventilator-associated pneumonia (VAP) in nursing home (NH) residents maintained on ventilatory support.**
- Schouten JA, Prins JM, Bonten MJ *et al.*: Revised SWAB guidelines for antimicrobial therapy of community-acquired pneumonia. *Neth. J. Med.* 63(8), 323–335 (2005).
- Woodhead M, Blasi F, Ewig S *et al.*: Guidelines for the management of adult lower respiratory tract infections. *Eur. Respir. J.* 26(6), 1138–1180 (2005).
- Hedlund J, Stralin K, Ortqvist A *et al.*: Swedish guidelines for the management of community-acquired pneumonia in immunocompetent adults. *Scand. J. Infect. Dis.* 37(11–12), 791–805 (2005).
- Memish ZA, Shibl AM, Ahmed QA *et al.*: Guidelines for the management of community-acquired pneumonia in Saudi Arabia: a model for the Middle East region. *Int. J. Antimicrob. Agents* 20(Suppl. 1), S1–S12 (2002).
- Memish ZA, Arabi YM, Ahmed QA *et al.*: Executive summary of the Gulf Cooperation Council practice guidelines for the management of community-acquired pneumonia. *J. Chemother.* 19(Suppl. 1), 7–11 (2007).
- Committee for The Japanese Respiratory Society: Guidelines for the management of community acquired pneumonia in adults. revised edition. *Respirology* 11(Suppl. 3), S79–S133 (2006).
- Working Group of the South African Thoracic Society: Management of community-acquired pneumonia in adults. *S. Afr. Med. J.* 97(12 Pt 2), 1296–1306 (2007).
- Infectious Diseases Society of Taiwan, Taiwan Society of Pulmonary and Critical Medicine, Medical Foundation in Memory of Dr. Deh-Lin Cheng *et al.*: Guidelines on antimicrobial therapy of pneumonia in adults in Taiwan, revised 2006. *J. Microbiol. Immunol. Infect.* 40(3), 279–283 (2007).
- Gialdroni Grassi G, Bianchi L: Guidelines for the management of community-acquired pneumonia in adults. Italian Society of Pneumology. Italian Society of Respiratory Medicine. Italian Society of Chemotherapy. *Monaldi Arch. Chest Dis.* 50(1), 21–27 (1995).
- Bantar C, Bavestrello L, Curcio D *et al.*: Acute community-acquired pneumonia in adults: guidelines for initial antimicrobial therapy based on local evidence from a South American Working Group (ConsenSur). *J. Chemother.* 14(Suppl. 4), 1–22 (2002).
- Mandell LA, Wunderink RG, Anzueto A *et al.*: Infectious Diseases Society of America/American Thoracic Society consensus guidelines on the management of community-acquired pneumonia in adults. *Clin. Infect. Dis.* 44(Suppl. 2), S27–S72 (2007).
- **Provides details on managing NH residents admitted to hospital for management of NH-acquired pneumonia (NHAP; general ward and intensive care unit).**
- Mandell LA, Marrie TJ, Grossman RF *et al.*: Summary of Canadian guidelines for the initial management of community-acquired pneumonia: an evidence-based update by the Canadian Infectious Disease Society and the Canadian Thoracic Society. *Can. Respir. J.* 7(5), 371–382 (2000).
- **The only community-acquired pneumonia guideline that attempts to provide useful diagnostic and therapeutic information for NH residents with NHAP (however, this guideline is somewhat dated).**
- Fine MJ, Auble TE, Yealy DM *et al.*: A prediction rule to identify low-risk patients with community-acquired pneumonia. *N. Engl. J. Med.* 336(4), 243–250 (1997).
- Ewig S, Welte T: CRB-65 for the assessment of pneumonia severity: who would ask for more? *Thorax* 63(8), 665–666 (2008).

17. Fried TR, Gillick MR, Lipsitz LA: Whether to transfer? Factors associated with hospitalization and outcome of elderly long-term care patients with pneumonia. *J. Gen. Intern. Med.* 10(5), 246–250 (1995).
 18. Fried TR, Gillick MR, Lipsitz LA: Short-term functional outcomes of long-term care residents with pneumonia treated with and without hospital transfer. *J. Am. Geriatr. Soc.* 45(3), 302–306 (1997).
 19. Naughton BJ, Mylotte JM: Treatment guidelines for nursing home-acquired pneumonia based on community practice. *J. Am. Geriatr. Soc.* 48(1), 82–88 (2000).
 20. Deglau J, Guay D, Straub K *et al.*: Effectiveness of oral antibiotic treatment in nursing home-acquired pneumonia. *J. Am. Geriatr. Soc.* 43(3), 245–251 (1995).
 21. Naughton BJ, Mylotte JM, Ramadan F *et al.*: Antibiotic use, hospital admissions, and mortality before and after implementing guidelines for nursing home-acquired pneumonia. *J. Am. Geriatr. Soc.* 49(8), 1020–1024 (2001).
 22. Mylotte JM, Naughton B, Saludades C *et al.*: Validation and application of the pneumonia prognosis index to nursing home residents with pneumonia. *J. Am. Geriatr. Soc.* 46(12), 1538–1544 (1998).
 23. Suchyta MR, Dean NC, Narus S *et al.*: Effects of a practice guideline for community-acquired pneumonia in an outpatient setting. *Am. J. Med.* 110(4), 306–309 (2001).
 24. Kruse RL, Mehr DR, Boles KE *et al.*: Does hospitalization impact survival after lower respiratory tract infection in nursing home residents? *Med. Care* 42(9), 860–870 (2004).
 25. Loeb M, Carusone SC, Goeree R *et al.*: Effect of a clinical pathway to reduce hospitalizations in nursing home residents with pneumonia: a randomized, controlled trial. *JAMA* 295(21):2503–2510 (2006).
 26. Mott PD, Parker WH: Hospital and medical care use by nursing home patients: the effect of patient care plans. *J. Am. Geriatr. Soc.* 36(1), 47–53 (1988).
 27. Jones JS, Dwyer PR, White LJ *et al.*: Patient transfer from nursing home to emergency department: outcomes and policy implications. *Acad. Emerg. Med.* 4(9), 908–915 (1997).
 28. Rubinstein LZ, Ouslander JG, Wieland D: Dynamics and clinical implications of the nursing home-hospital interface. *Clin. Geriatr. Med.* 4(3), 471–491 (1988).
 29. Lynn J: Hospitalization of nursing home residents: the right rate? *J. Am. Geriatr. Soc.* 45(3), 378–379 (1997).
 30. Mehr DR: Nursing home acquired pneumonia: how and where to treat? *J. Am. Board Fam. Prac.* 10(2), 168–169 (1997).
 31. Zimmer JG: Nursing home-acquired pneumonia: avoiding the hospital. *J. Am. Geriatr. Soc.* 45(3), 380–381 (1997).
 32. van der Steen JT, Muller MT, Ooms ME *et al.*: Decisions to treat or not to treat pneumonia in demented psychogeriatric nursing home patients: development of a guideline. *J. Med. Ethics* 26(2), 114–120 (2000).
 33. van der Steen JT, de Graas T, Ooms ME *et al.*: When should physicians forgo curative treatment of pneumonia in patients with dementia? using a guideline for decision-making. *J. Am. Geriatr. Soc.* 52(5), 691–699 (2004).
 34. Carusone SC, Loeb M, Lohfeld L: Pneumonia care and the nursing home: a qualitative descriptive study of resident and family member perspectives. *BMC Geriatrics* 6, 2 (2006).
 35. Ramsdell J, Narsavage GL, Fink JB *et al.*: Management of community-acquired pneumonia in the home: an American College of Chest Physicians clinical position statement. *Chest* 127(5), 1752–1763 (2005).
 36. Muder RR, Aghababian RV, Loeb MB *et al.*: Nursing home-acquired pneumonia: an emergency department treatment algorithm. *Curr. Med. Res. Opin.* 20(8), 1309–1320 (2004).
- **Nice evidence-based evaluation and treatment guideline authored by experts in the field of NHAP.**
37. Mehr DR, Binder EF, Kruse RL *et al.*: Predicting mortality in nursing home residents with lower respiratory tract infection. the Missouri LRI Study. *JAMA* 286(19), 2427–2436 (2001).
- **The NH equivalent of the Pneumonia Outcomes Research Trial (PORT) study, with data limited solely to NH residents.**
38. Ewig S, Kleinfeld T, Bauer T *et al.*: Comparative validation of prognostic rules for community-acquired pneumonia in an elderly population. *Eur. Respir. J.* 14(2), 370–375 (1999).
 39. Loeb M, Bentley DW, Bradley S *et al.*: Development of minimum criteria for the initiation of antibiotics in residents of long-term-care facilities: results of a consensus conference. *Infect. Cont. Hosp. Epidemiol.* 22(2), 120–124 (2001).
- **Summary of a consensus conference of North American NH infectious diseases experts, which provided minimum criteria for the initiation of antimicrobial therapy for a host of infectious disease types (including pneumonia) in the NH setting.**
40. Meehan TP, Fine MJ, Krumholz HM *et al.*: Quality of care, process, and outcomes in elderly patients with pneumonia. *JAMA* 278(23), 2080–2084 (1997).

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